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REPORT ON WATER POLLUTION CONTROL - SAN DIEGO BASIN, CALIFORNIA DRAINAGE BASIN

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San Francisco, California

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CINCINNATI, OHIO

REPORT

ON

WATER POLLUTION CONTROL

SAN
DIEGO
BASIN

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Water Pollution Series No. 30

Report on
Water Pollution Control
SAN DIEGO BASIN
California Drainage Basin

Prepared by:

FEDERAL SECURITY AGENCY
Public Health Service
U.S. Division of Water Pollution Control
California and Great Basin Drainage Basins Office

in cooperation with

California State Water Pollution Control Board
San Diego Regional Water Pollution Control Board

1951

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INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

In developing these programs, due regard must be given to improvements necessary to conserve the Nation's waters for public water supplies, propagation of fish and aquatic life, recreational purposes, agricultural, industrial, and other legitimate uses.

Recognizing the fact that full technical information was not available to permit the development of such comprehensive programs immediately for most of the Nation's waters, the Public Health Service envisioned the development of a series of reports to cover the interim period prior to the development of comprehensive water pollution control programs. The first of these reports were the Summary Reports which were prepared for the 15 major drainage basins of the country on the basis of information readily available as of July 1, 1950. The second group of reports of this series, of which this is one, are reports on several subdivisions of the country's major drainage basin areas. Since development of comprehensive water pollution control programs is to proceed as rapidly as conditions permit, only a limited number of these interim reports are to be completed, and the majority of these will be for interstate areas. These reports will provide a reference point for measuring progress; provide a guide to needed additional data; provide a basis for the logical development of comprehensive programs; provide a basis for approval of loans to States, interstate agencies and municipalities at such time as the Congress makes available funds for this purpose; and serve to inform the public on the water pollution control problem and needs for the area concerned.

The data on which this report is based have been compiled through and in cooperation with State water pollution control agencies, but should not be considered a detailed engineering investigation of the San Diego Basin. Through these cooperating agencies additional data have been obtained from other State officials, county and city officials and representatives of industry. Federal agencies also have been of great assistance.

The 1949 California legislation which established the State and Regional water pollution control boards also defined the terms "contamination", "pollution", and "nuisance" as follows: "'Contamination' means an impairment of the quality of the waters of the State by sewage or industrial waste to a degree which creates an actual hazard to the public health through poisoning or through the spread of disease. 'Pollution' means an impairment of the quality of the waters of the state by sewage or industrial waste to a degree which does not create an actual hazard to the public health but which does adversely and unreasonably affect such waters for domestic, industrial, agricultural, navigational, recreational or other beneficial use. 'Nuisance' means damage to any community by odors or unsightliness resulting from unreasonable practices in the disposal of sewage or industrial wastes."

In view of the special significance attached to the use of these terms in California, the words are shown in quotation marks when the California meaning is intended.

Since California Legislation requires that Regional Boards hold public hearings before they determine if a condition of "pollution" or "nuisance" is existing or threatening to exist as a result of discharge of sewage or industrial waste within its region, and since the law specifies that: "No order issued under the provisions of this article shall specify the design, location, type of construction or particular manner in which an operation causing or threatening to cause a condition of pollution or nuisance is to be corrected, and the person so ordered shall be permitted to correct the condition in any lawful manner", regional authorities cannot pass upon the adequacy or inadequacy of existing treatment and disposal facilities in advance of technical studies and hearings and cannot specify type of treatment facilities that should be provided. In view of these restrictions, it is difficult on the basis of present information to designate the adequacy of many of the waste treatment facilities in the Basin as satisfactory or unsatisfactory, and they are listed in the report as undetermined.

These reports present information about the ways the water resources of the area are used, the pollution entering those water resources and the resulting damages, the benefits which may result from pollution prevention and abatement, pollution prevention measures now in effect, and those which appear to be needed.

Since this report is based on admittedly incomplete data available as of March 1, 1951, no attempt has been made to determine the future best uses of the water resources of the Basin as related to pollution control. Such water use determinations are dependent upon development of a long range comprehensive program, beyond the scope of this report.

The deficiencies in data and the gaps in information indicated in the report are as significant as the presentation of available facts and statistics.

These gaps in data will be filled by the county-wide sewerage survey, for which the San Diego County Board of Supervisors appropriated $50,000.00, now being conducted by a Board of Consulting Engineers. The plan developed by the Board of Consulting Engineers in cooperation with the Regional Water Pollution Control Board for solving the waste disposal problems in the Basin together with the action program recommended to complement the plan can be adopted as the comprehensive program which Public Law 845 requires the Surgeon General of the Public Health Service to prepare or adopt.

A sincere effort has been made by all who contributed to this report to present a fair picture of the complex water pollution problems in the area and to present reasonable conclusions and recommendations. It is our hope that this report, as a step in the cooperative development of an ultimate comprehensive water pollution control program, will help in safeguarding the water resources of the San Diego Basin.

ACKNOWLEDGMENTS

This report has been prepared by the California and Great Basin Drainage Basins Office of the Public Health Service in cooperation with the California State and Regional Water Pollution Control Boards and the State Department of Public Health. Other California State agencies which furnished valuable assistance are: Department of Public Works, Division of Water Resources; Department of Natural Resources, Division of Fish and Game, and Division of Forestry, Department of Agriculture; and University of California.

Federal agencies which assisted in review of the manuscript and from whose reports much data were obtained include: Department of Agriculture, Forest Service and Soil Conservation Service; Department of the Army, Corps of Engineers; Department of Commerce, Bureau of the Census; Department of the Interior, Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, and National Park Service; and Federal Power Commission.

The California State Chamber of Commerce, and other organizations and individuals including public officials and engineers in private practice have also contributed information.

The highway map, following the General Reference Map, is a copyright publication of the National Automobile Club and is used by the courtesy of that organization.

Special acknowledgment is made for use of the material on water problems of San Diego County prepared especially for this report by the San Diego County Water Authority.

California State Water Pollution Control Board

RESOLUTION NO. 52-1

AUTHORIZING CLEARANCE ON THE U.S. PUBLIC HEALTH SERVICE REPORT ON WATER POLLUTION CONTROL FOR THE SAN DIEGO BASIN

WHEREAS, in accordance with Public Law 845, 80th Congress, the California and Great Basin Drainage Basins Office, Division of Water Pollution Control, Public Health Service, Federal Security Agency, has prepared a report entitled "Report on Water Pollution Control, San Diego Basin", dated March 1, 1951; and

WHEREAS, on November 21, 1951, the State Water Pollution Control Board (as the State agency designated by the Surgeon General of the U. S. Public Health Service) was requested to review and comment upon a preliminary draft of said Report for the purpose of giving State clearance of the Report prior to ultimate reproduction and release by the Public Health Service; and

WHEREAS, the State Board did, by motion adopted on December 6, 1951, authorize the Chairman to give tentative clearance to said Report with the following provisions: (1) that, after receiving comments from all agencies and individuals concerned, the Executive Officer recommend to the Public Health Service any necessary changes; (2) that there be no controversial items in the Report; and (3) that final clearance of the Report be subject to action by the Board at the next regular meeting; and

WHEREAS, the State Department of Fish and Game, the State Department of Public Health, and the State Division of Water resources have reviewed and commented upon said Report; and

WHEREAS, changes in said Report have been recommended by the State Board and the San Diego Regional Water Pollution Control Board based on (1) their review of the Report and (2) the comments received from the other three State agencies; and

WHEREAS, comments were not received and final review of the Report was not completed sufficiently in advance of this meeting to warrant giving tentative clearance as authorized at the December 6 meeting of the Board;

NOW, THEREFORE, BE IT RESOLVED that the State Board give clearance for reproduction and release of said Report provided that the changes recommended by and on file in the office of the Board be incorporated in the Report prior to its reproduction and release; and

BE IT FURTHER RESOLVED that the State Board compliment the California and Great Basin Drainage Basins Office of the U.S. Public Health Service and the San Diego Regional Water Pollution Control Board on the excellence of said Report; and

BE IT FURTHER RESOLVED that the Executive Officer of the State Board be directed to forward a copy of this Resolution to the California and Great Basin Drainage Basins Office, Division of Water Pollution Control, U. S. Public Health Service, San Francisco, and to the San Diego Regional Water Pollution Control Board.

/s/ Warren T. Hannum
Warren T. Hannum
Chairman

I, Vinton W. Bacon, Executive Officer of the State Water Pollution Control Board, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the State Water Pollution Control Board at the Board meeting held on March 6, 1952.

/s/ Vinton W. Bacon
Vinton W. Bacon
Executive Officer

SUMMARY

The City of San Diego, the oldest in California, was founded in 1769 as the first of the famous California Missions. A masonry dam and tile lined aqueduct built around 1774, the first irrigation project in California, can still be traced along the bed of the San Diego River. Modern water supply development began in 1887 with construction of Sweetwater Reservoir to irrigate lands granted to the California Southern Railway.

The San Diego Basin coincides with San Diego State Water Pollution Control Region No. 9 and comprises 3,930 square miles in the southwestern corner of California. Approximately 800 square miles of the Basin area is level mesa or rolling hills along the coastal plain and narrow interior valleys. The remaining 80 percent of the Basin area is mountainous with elevations ranging up to 6,500 feet.

Climate along the coastal plain is semitropical and uniform with cool moist winters and warm dry summers. Seasonal precipitation averages 10 inches along the coast and increases inland to more than 40 inches at elevations above four or five thousand feet. Killing frosts are rare along the coast, and the growing season may be considered as 365 days. The delightful year-around climate has made the area famous as both winter and summer playground.

The population of the Basin was 293,900 in 1940 and 542,000 in 1950, an increase of 84.4 percent in the ten-year period as compared to an increase of 51.6 percent for the State of California and 14.5 percent for the United States during the same period. Approximately 60 percent of the Basin population is concentrated in the City of San Diego and 75 percent in the eight largest communities.

The Basin economy is based on industries, agriculture, Navy payrolls and the tourist trade. Aircraft production, tuna packing and ship building led the industries in producing a $78 million industrial payroll in 1949. Animal husbandry products, truck crops and fruits and nuts led in the value of agricultural crops worth $62 million in 1949. The area is particularly noted for its avocados, lemons, and exotic semitropical fruits. The Navy's payrolls in 1949 included $55 million to active duty personnel and $42 million to civilians employed in the San Diego area. Tourists spent an estimated $54 million in San Diego County in 1949 resulting in direct employment of approximately 7,500 persons.

In 1949 the total farm acreage in San Diego County was estimated at 917,562. The farm acreage for the Basin would be approximately the same as for the County. Only 56,377 acres were irrigated and the rest dry farmed or used for pasture.

Over half of the area of San Diego County is non-taxable lands, 172,127 acres being in U. S. Military Camps, 110,036 acres in Indian Reservations, 415,672 acres in State Parks, 276,298 acres in National Forests and 409,397 acres in Public Domain. Lumber and mineral production in the Basin are relatively unimportant.

From the standpoint of natural water resources, the Basin is considered to be one of the poorest in California. There are 25 named streams in the area, only four of which, the Santa Margarita, San Luis Rey, San Diego and Tia Juana Rivers, have drainage areas in excess of 400 square miles. Annual rainfall is low and runoff erratic. The mean seasonal runoff of streams in the Basin, not including that part of the Tia Juana River lying in Mexico or the streams in the Orange County portion of the Basin, averaged 302,050 acre-feet per year for the period from 1887 to 1933. The maximum safe yield of these streams for the same period by both surface and ground water storage is estimated to be 161,57 acre-feet per year. The most economical and accessible storage reservoir sites have already been developed. Further reservoir construction will grow increasingly costly as conservation storage approaches full utilization of flood flows. Under Section 230 of the Water Code of California, the Department of Public Works is directed to study the feasibility of reclaiming waste waters for industrial or agricultural use.

The need for pollution prevention measures, adequate to protect existing water supplies, is emphasized by this fact - that local water resources are limited.

Present average water use in the Basin is estimated to be 160,000 acre-feet annually, approximately half for community water supply and half for irrigated agriculture. During normal years approximately 115,000 acre-feet of water is available from local sources, stream diversions, surface reservoirs, and wells. During the recent period of subnormal rainfall, however, much less water has been available from local sources. The deficit between the 160,000 acre-feet annual consumption and 115,000 acre-feet normally furnished by local sources is being made up by water imported from the Colorado River through the San Diego Aqueduct designed by the Bureau of Reclamation and built by the Navy (1945-47) as an emergency war measure. The aqueduct is delivering an average of 70,000 acre-feet per year by gravity from the takeoff at the west portal of the San Jacinto Tunnel of the Metropolitan Water District Colorado River Aqueduct to the San Vicente Reservoir, a distance of 71.1 miles.

The most optimistic estimate for immediate future development of additional water supplies in the Basin are 25,000 acre-feet additional from local sources and 50,000 acre-feet additional from the Colorado River by construction of the second barrel of the San Diego Aqueduct. The potential 75,000 acre-feet additional water would permit irrigation of an additional 58,000 acres of land disregarding increased community water consumption due to increased population and industrial activity. Since the additional arable land that could be developed by irrigation is variously estimated at from 100,000 to 360,000 acres, it is clear that even with development of all local sources and construction of the second barrel of the aqueduct, there will still be insufficient water available to permit full development of the resources of the Basin.

There are 45 sewered communities discharging wastes with a population equivalent of approximately 366,000 and 12 known industries discharging wastes with a population equivalent of approximately 145,000 to the water resources of the Basin. Approximately 96.5 percent of the wastes are discharged to the ocean or tidal waters, 3.1 percent to surface streams or watercourses, and 0.4 percent to land disposal systems As would be expected with such a large proportion of wastes discharged to the ocean, most of the damage to the water resources has occurred along the beaches and coastal waters.

Forty-three of the communities in the Basin have constructed 22 primary and 22 secondary treatment plants serving a total population of 547,635. Two communities with a combined population of 14,600 have provided no treatment and discharge raw sewage to San Diego Bay. Six of the 12 known industries with separate outlets have provided minor or primary treatment and six have no treatment facilities.

Coordination of water pollution control activities of the various State agencies and political sub-divisions concerned as well as control of the economic effects of sewage and industrial wastes in the Basin are the duties of the Regional Water Pollution Control Board formed as a result of comprehensive changes in water pollution control legislation enacted by the California Legislature in 1949. The Board is studying the major pollution problems of the Region and has requested six special surveys to be conducted in 1951-52 by the State Division of Water Resources and Departments of Public Health and Fish and Game at a total cost of $12,500 to help fill in gaps in information as to the effect on the water resources of the Region of domestic and industrial waste discharges.

The major pollution control problems along the coast are in the San Diego Bay area and in the vicinity of the San Ysidro-Tijuana, Carlsbad, Oceanside and Capistrano Beach sewer outfalls. Inland the most serious problems are in the rapidly growing El Cajon Valley and South Bay areas and in the fringe areas around San Diego Bay cities. In order to aid the solution of these problems, the Regional Water Pollution Control Board is advocating joint planning between all agencies and individuals involved and is encouraging the collection of sufficient information to permit orderly development and consummation of long-range plans.

There are no interstate pollution problems, but discharge of wastes from a sewered population of about 26,500 in Tijuana, Mexico to the San Diego Basin may cause an international problem of considerable local significance.

CONCLUSIONS

1. Irrigated agriculture and community water supply are water uses of approximately equal importance in the Basin.

2. From the standpoint of natural water resources, the Basin is one of the poorest in California, making pollution control of major economic importance.

3. Ground water basins are not extensive, and ground water supplies are relatively less important than local and imported surface supplies.

4. Present average water use is estimated at 160,000 acre-feet annually, 70,000 acre-feet or 44 percent of which is imported from the Colorado River.

5. The most optimistic estimates for the immediate future development of additional water supplies are insufficient to permit full urban and agricultural development of the Basin. In view of the critical water supply situation in the area, it is of utmost importance to consider reclamation of waste waters.

6. Protection of the recreational value of beaches in the Basin is widely recognized to be of utmost importance.

7. Unprecedented increases in population make the provision of adequate community severage facilities difficult.

8. Important gaps exist in available information on pollution prevention measures required.

9. Under the Regional Water Pollution Control Board program, coordinated and comprehensive studies, necessary for the formulation and adoption of long-range plans and policies, are being conducted with a view to filling gaps in information and communities are being encouraged to develop master plans for sewage collection and pollution prevention facilities.

RECOMMENDATIONS

1. Comprehensive long-range sewerage plans for the San Diego Basin, particularly the metropolitan San Diego and other rapidly growing areas, should be continued and encouraged.

2. Investigations now being conducted by the Regional Board to fill the present gaps in information on pollution sources and damage therefrom should be encouraged and supported.

3. Upon completion of master plans, in accordance with the Regional Water Pollution Control Board requirements and long-range program, all agencies should be encouraged to take appropriate action to insure their adoption and consummation.

4. As specific programs, based on requirements prescribed by the Regional Water Pollution Control Board are developed, authorities should proceed with construction of necessary facilities without delay.

5. The valuable beaches of the Basin should be protected by adequate waste treatment and/or adequate ocean outfalls.

6. Research programs being conducted by the State Water Pollution Control Board on the technical problems of domestic and industrial waste treatment should be continued, as they will be particularly important to this Basin where water conservation is a prime consideration.

7. Local, State, and Federal agencies should cooperate fully in expanding public information programs on the subject of water pollution.

GENERAL DESCRIPTION

Historical Background

San Diego Bay was discovered by Juan Rodriguez Cabrillo, a Portuguese navigator in Spanish service, who in 1542 commanded the first expedition to sail along the coast of California. Sebastian Viscaino anchored in the Bay from November 10 to 14, 1602, and named it in honor of San Diego de Alcala de Henares, whose feast day was November 12.

The Mission San Diego de Alcala, founded in 1769 by Fra Junipero Serra at what is now Presidio Park, was the first of the famous California Missions. This Mission marked the beginning of El Camino Real (the king's highway) which extended into northern California, with 21 Missions built a "days journey" apart. In 1774 the Mission was moved six miles up the San Diego River Valley to assure an adequate water supply and bountiful crops. A masonry dam and tile lined aqueduct built in these early years, the first irrigation project in California, may still be traced along the bed of the river.

Spanish authorities settled and fortified San Diego against the threat of British and Russian explorers after Captain George Vancouver, British Explorer, brought the first foreign ship into San Diego Bay in 1793. Mexico's revolt from Spain opened the port to foreign trade; and San Diego became the first Capital of California when General Jose M. Echeandia, the first duly appointed Mexican Governor, arrived in 1825.

As a result of the war between the United States and Mexico, Major John C. Fremont, U.S.A., and his California Battalion of 166 men arrived at San Diego July 29, 1846, on the U. S. Sloop-of-War "Cyane." General Stephen W. Kearney, U.S.A., also made his famous overland march from Fort Leavenworth, Kansas, in 1846, arriving in San Diego on December 12.

The County of San Diego was created and named by Act of the California Legislature, February 18, 1850, as one of the original 27 California Counties. The town of San Diego, the oldest in California, was incorporated as a City by Act of the State Legislature March 27, 1850.

Modern water supply development began with completion of the California Southern Railway (now the Atchison, Topeka and Santa Fe Railway) in 1885. Previous to this time, only a few ditches had been constructed, and the area irrigated was in small and scattered tracts.

A grant of 10,000 acres of the best lands of Rancho de la Nacion as well as other lands had been made to the railroad. This led to construction of Sweetwater Reservoir on Sweetwater River in 1887 to provide a municipal water supply for National City and an irrigation supply for adjoining agricultural lands.

The Escondido Irrigation District formed under the Wright Act in 1887 and predecessor of the Escondido Mutual Water Company, built the Escondido diversion works on the San Luis Rey River, the conduit and Bear Valley (Wohlford) Reservoir, bringing an irrigation supply to the Escondido Valley in 1895.

Following preliminary surveys, the San Diego Flume Company, conceived by T. S. Van Dyke, a Mr. Robinson, and General Marlette, and incorporated in 1885, constructed Cuyamaca Dam in 1886 and 1887, and from 1885 to 1888 constructed a 36 mile wooden flume. This flume, with an initial capacity of 16 sec. ft. and designed for future enlargement to provide 100 sec. ft., served as the main source of supply for what is now the La Mesa, Lemon Grove, and Spring Valley Irrigation District (formed in 1913), and until 1910 was also the primary source of the City of San Diego.

The Southern California Mountain Water Company, incorporated in 1895, took over the properties of the Mount Tecate Land and Water Company on Cottonwood Creek of the Tia Juana River, and the Otay Water Company on the Otay River starting construction of the Upper and Lower Otay and Morena Dams about 1896. In 1909 the Dulzura conduit for diversions of water from Cottonwood Creek to the Otay River Basin was completed and in 1912 the Morena Dam, work on which had been discontinued after it reached a height of 30 feet, was finally completed. The City of San Diego purchased this system in 1913, replaced the Lower Otay Dam which failed during the flood of 1916, built the Barrett Reservoir in 1922 and increased the capacity of the Morena Reservoir three times.

Another major development occurred in 1918, when the Santa Fe Land Improvement Company built Hodges Dam and Reservoir on the San Dieguito River, the City of San Diego acquiring the development in 1925.

In 1922, the San Diego Water Company built Henshaw Reservoir on the San Luis Rey River to provide an irrigation supply for the Vista Irrigation District and a supplementary supply for the Escondido Mutual Water Company.

In 1933 and 1943 the City of San Diego completed, respectively, El Capitan Reservoir on the San Diego River and San Vicente Reservoir on San Vicente Creek, a tributary of the San Diego River.

In 1944, the San Diego County Water Authority was organized with five cities, three irrigation districts and one public utility district as members for the primary purpose of importing Colorado River water to San Diego County. The population of the constituent areas of the authority totaled 434,777 or 81 percent of the population of the Basin based on the 1950 census.

In 1947, the initial flow of Colorado River water passed through San Diego Aqueduct into San Vicente Reservoir. The aqueduct has operated at full capacity since it was placed in operation, delivering 71,570 acre-feet of water during the 1949 fiscal year and 69,264 acre-feet during the

1950 fiscal year. The areas served by the San Diego County Water Authority used a total of 90,160 acre-feet of water in 1950 of which 56,072 or 62 percent was Colorado River water.

The drouth which started in 1946 has continued. During 1950 there was no measured runoff from the drainage basins into surface reservoirs serving Authority agencies and the quantity of water in storage was reduced to 77,260 acre-feet or 17 percent of the 465,389 acre-feet capacity of existing surface storage reservoirs.

Physical Description

Geographic - The San Diego Basin, which coincides with the San Diego State Water Pollution Control Region No. 9, is in the southwestern corner of California and comprises all drainage basins discharging to the Pacific Ocean between the Santa Ana River Basin and the Mexico-California border. (Map 1) The Basin is roughly rectangular in shape, extending 90 miles northwesterly along the Pacific coast from the Mexican Border and from 40 to 100 miles northeasterly inland from the coast. The total area of the Basin is approximately 3,930 sq. mi., 260 sq. mi. being in Orange County, 650 sq. mi. in Riverside County and 3,020 sq. mi. in San Diego County. An additional 1,264* sq. mi. in Baja California, Mexico, representing roughly two-thirds of the drainage area of the Tia Juana** River, is not considered in the report except for the wastes discharged to the Tijuana-San Ysidro outfall sewer from Tijuana**, Mexico. The Basin is bounded on the north by the Santa Ana River Basin, on the south by Baja California, Mexico, and on the west by the Pacific Ocean. (Table 3, Appendix)

Topographic - The Basin is cut by a rugged chain of mountains known as the Peninsula Ranges which emerge from the San Jacinto and Santa Ana Ranges in Riverside County and extend southeasterly, roughly paralleling the coast line, to form the backbone of the lower California peninsula.

Approximately 800 sq. mi. of the Basin area is level mesa or rolling hills along the coastal plain and narrow interior valleys. In the southern part of the Basin some of the coastal plain merges into swamps or marshland along the coast. The remaining 80 percent of the Basin area is mountainous. Elevations in the highland area average more than 3,000 feet with Morgan Hill and Middle Peak above 5,000 feet, Palomar Mt. and North Peak above 6,000 feet, and Cuyamaca Peak and Hot Springs Mt. above 6,500 feet.

There are 25 named and several smaller streams draining to the ocean in the San Diego County portion of the Basin. Four of the 25, the Santa Margarita, San Luis Rey, San Diego, and Tia Juana Rivers are major streams each with drainage areas in excess of 400 sq. mi. Two rivers,

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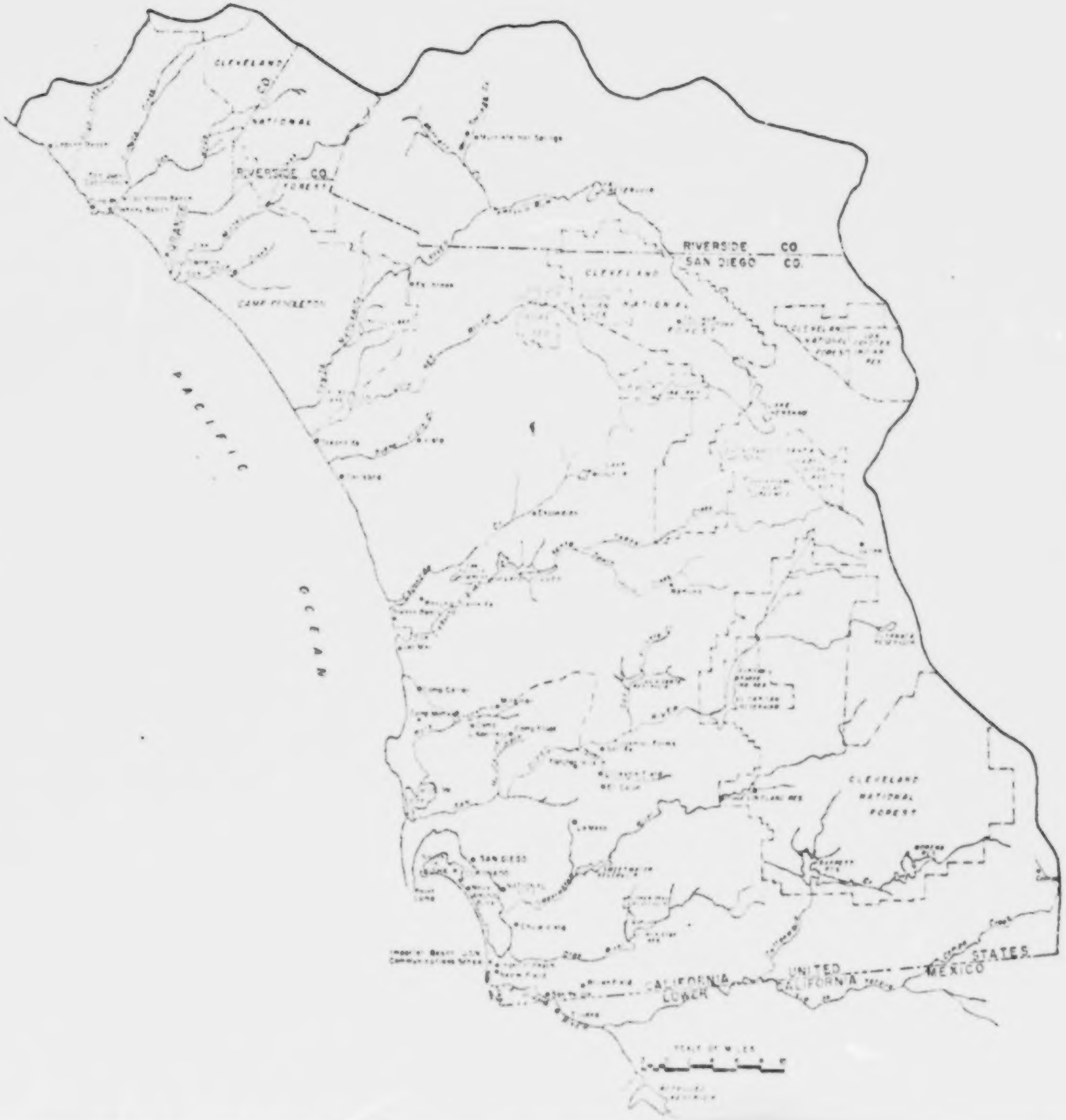
*The drainage area of the Tia Juana River, according to the International Boundary and Water Commission, is 1,724 square miles, of which 460 are in the United States (San Diego Basin) and 1,264 in Mexico. These figures are used throughout the report except where other authorities are quoted. The Department of the Army considers the total drainage area to be 1,680 square miles (Table 4, p. 13, appendix) and the California Department of Public Works, Division of Water Resources, states that its area within the U. S. is 461 square miles (Table 6, p. 15, appendix).

**In this report, "Tia Juana River" is used because it is preferred by the U. S. G. S. The city is spelled "Tijuana," which is preferred by Mexico. In quoted documents, the author's spelling is used.


RIVERSIDE CO.
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RIVERSIDE CO.
CLEVELAND NATIONAL FOREST
CAMP PENDLETON
CLEVELAND NATIONAL FOREST
PACIFIC OCEAN
SAN DIEGO
UNITED STATES
MEXICO
CALIFORNIA
LOWER CALIFORNIA
SCALE OF MILES

SAN DIEGO BASIN
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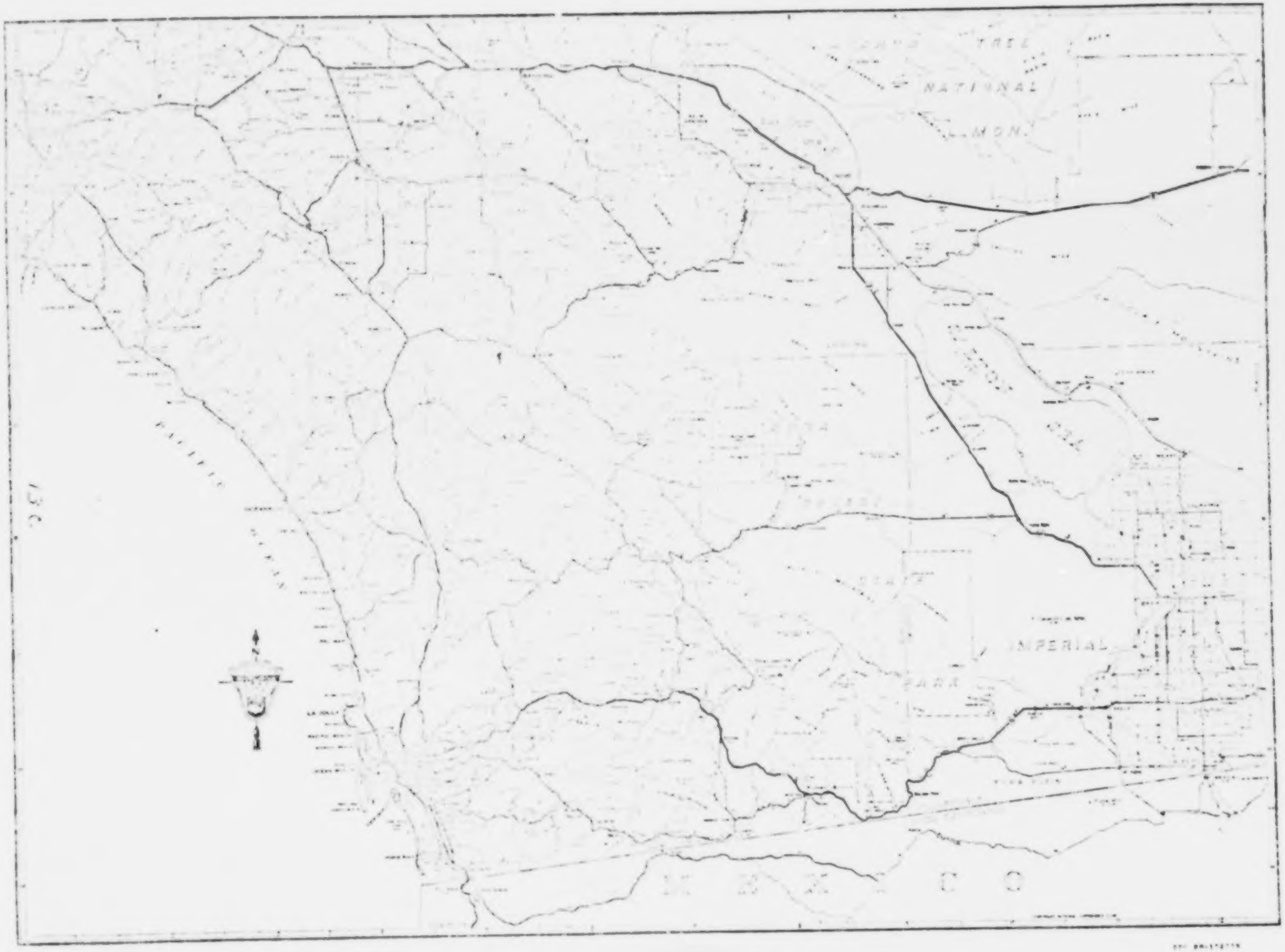
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the San Dieguito and Sweetwater, each drain areas in excess of 200 sq. mi., and two additional streams, Otay River and San Mateo Creek drain areas in excess of 100 sq. mi.

In the mountainous areas the principal streams have cut deep, narrow canyons with occasional highland valleys. Across the coastal plain the major streams flow through broad valleys. The minor streams have, in most cases, cut only narrow canyons in the mountains and inadequate flood channels across the coastal plain. General information on the streams in the San Diego County portion of the Basin are shown in Table 4, Appendix.

There are two additional named streams, San Juan Creek and Aliso Creek, as well as several smaller creeks draining to the ocean in the Orange County portion of the Basin.

Stream slopes vary greatly in the mountains because of faults and changes in rock formations. Channel slopes at higher elevations vary from 50 to 280 feet per mile. In the coastal plain, slopes vary from 7 to 57 feet. Underground basins occupy only a small part of the total area of the region and in the upper valleys are narrow and shallow. In the coastal plain usable ground water storage is limited by the threat of sea water intrusion. The channels of most of the streams are dry during the greater part of the year.

The rocks of the Basin are composed of two main groups, the basement complex of hard, highly crystalline, metamorphic and igneous rocks of the mountainous inland region and the softer sedimentary rocks such as sandstone, shale and limestone, overlying the basement complex near the coast. Many of the prominent topographic features of the area are the result of faulting and uplifts. The eastern, mountainous part of the Basin has been uplifted to form a high plateau while the western, coastal area has been formed as a series of terraces produced by wave action and successive uplifts. There are two principal faults in the northern part of the Basin, one on each side of Lake Henshaw.

Climatic - Along the coastal plain of the Basin, the climate is semitropical and uniform. Winters are cool and moist, and summers are warm and dry. Killing frosts are so rare that the annual growing season can be considered as 365 days. Seasonal precipitation along the coast averages 10 inches with about 80 percent falling from December to March, inclusive. Humidity along the coast averages 75 percent, and the number of days for which measurable amounts of rainfall are recorded average 44. Prevailing winds averaging about five miles per hour are from the ocean.

The delightful year-around climate has made the coastal areas of the Basin renowned as both winter and summer playground. The average daily range between high and low temperatures is only 13 degrees, and the variation in mean temperatures in the hottest and coldest months is only 14 degrees.

In the higher areas inland from the coastal plain winter temperatures are lower and precipitation heavier than in the coastal region. At elevations above four or five thousand feet snowfall is common and annual precipitation may exceed 40 inches or four times that along the coast. The mountains receive only a very small portion of their winter precipitation as snow, however, so no large runoffs from snow melt are available. The snow that does fall usually disappears by evaporation with very little effect on stream runoff.

In general, climatological conditions causing drought or floods will be common to all streams in the Basin. Climatological data from nine stations varying from 87 to 5,000 feet in elevation are shown in Table 5, Appendix.

Hydrologic - Starting at the north, the only stream of importance in the Orange County portion of the Basin is San Juan Creek which, with its main tributary Trabuco Creek, has a drainage area of 146.5 sq. mi. above gaging stations near San Juan Capistrano. The average discharge of San Juan Creek, drainage area 110 sq. mi., is 15.8 second-feet or 11,439 acre-feet annually for 20 years of record. The average discharge of Trabuco Creek, drainage area 36.5 sq. mi., is 6.71 second-feet or 4,858 acre-feet annually for 18 years of record.

The five northernmost streams in San Diego County--San Mateo Creek, San Onofre Creek, Horno Creek, Las Pulgas Creek and Aliso Canyon -- rise in the Elsinore and Santa Margarita Mountains and flow southwesterly across rugged and relatively unimproved areas to the Pacific Ocean. The total drainage area of the five streams is only 216 sq. mi. No data are available as to the average annual runoff from these streams.

The Santa Margarita River, which empties into the Pacific approximately 117 shore line miles* north of the Mexican Border, drains the second largest watershed in the Basin. The River is formed by the junction of Temecula and Murrieta Creeks, 28.4 river miles from the coast near the northwestern end of the Agua Tibia Mountains. The river flows about 18 miles through a deep canyon and then 10.4 miles through a broad valley to the ocean. The total drainage area is 743 sq. mi., 548 sq. mi. in Riverside County and 195 sq. mi. in San Diego County. The mean seasonal runoff from the 710-sq. mi. area above the lowest potential reservoir site for the 46-year period from 1887 to 1933 is 24,050 acre-feet (Table 6, Appendix).

The San Luis Rey River, draining the third largest watershed in the Basin, empties into the Pacific only 2.4 miles south of the mouth of the Santa Margarita River. The stream rises in the Chihuahua Valley, east of the Aguanga Mountains, and roughly parallels the Santa Margarita River. The drainage area comprises 565 sq. mi., of which all but 1.5 sq.

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* Shore line miles are measured along the entire shore line, including major indentations such as San Diego Bay.

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mi. are in San Diego County. Mean seasonal runoff for the 46-year period from 1887 to 1933 is 55,210 acre-feet for the 518 sq. mi. area above the lowest potential reservoir site, the greatest runoff of any of the watersheds in the Basin.

Four small streams -- Loma Alta, Buena Vista, Agua Hedionda, and San Marcos Creeks -- drain the southwestern slopes of the San Marcos and Merriam Mountains and empty into the ocean within a distance of 8.8 miles south of the San Luis Rey River. Loma Alta and Agua Hedionda Creeks flow through relatively undeveloped areas, but Buena Vista Creek flows through Vista and San Marcos Creek flows through the town of San Marcos. The four streams drain a total area of only 114 sq.mi.

Escondido Creek empties into the Pacific Ocean 101 shore line miles north of the Mexican Border. The Creek originates at Lake Wohlford, seven miles northeast of Escondido and flows 26 miles southwest to the coast. The stream passes through the rapidly growing city of Escondido and a highly improved valley area. The drainage area comprises 88 sq. mi.

San Dieguito River, another major stream, discharges to the ocean 2.5 miles south of the mouth of Escondido Creek. Santa Ysabel Creek, the principal tributary of the San Dieguito River, rises on the southwest slope of Volcan Mountain and flows west 32.5 miles to join Santa Maria Creek, three miles northeast of the upper end of Lake Hodges. The Lake occupies 6.5 miles of canyon above Hodges Dam at river mile 13 from its mouth. The drainage area comprises 347 sq. mi. Mean seasonal runoff for the 46-year period of record from 1887 to 1933 for the 303 sq. mi. area above the lowest potential reservoir site is 39,340 acre-feet.

Soledad, Rose,and Tecolote Creeks drain the area between the San Dieguito and San Diego Rivers. The total drainage area of the three streams comprises 144 sq. mi. Soledad Creek, the largest of the three, rises on a terrace near Linda Vista and flows northwest near the town of Sorrento about eight miles to the ocean.

San Diego River, draining the fourth largest watershed in the Basin, enters Mission Bay in the northwestern part of the City of San Diego, 70.2 shore line miles north of the Mexican Border. The River rises in the mountains near Santa Ysabel and flows 52 miles southwest to the coast. San Vicente Creek, the principal tributary, rises near Mount Gower and flows parallel to the river to its confluence with the main stream at river mile 24 from the mouth. San Vicente Dam is located on the Creek three miles above its confluence with the river. The total drainage area of San Diego River is 435 sq. mi. Mean seasonal runoff for the 376 sq. mi. area above the lowest potential reservoir site is 47,560 acre-feet for the 46-year period of record 1887 to 1933, the second largest runoff of any of the watersheds in the Basin.

Switzer, Las Chollas, La Paleta, and Paradise Creeks drain much of the San Diego Metropolitan area and discharge to San Diego Bay. The total drainage area of the four creeks comprises 38 sq. mi.

The Sweetwater River, draining an area of 221 sq. mi., rises in the Laguna Mountains near the Cuyamaca Reservoir and flows 46 miles southwest to Sweetwater Dam which forms Sweetwater Reservoir occupying about three miles of the valley. Below the dam, the river flows 9.3 miles southwest and discharges into a salt marsh of San Diego Bay south of National City and 42.8 shore line miles north of the Mexican Border. Mean seasonal runoff for the 181 sq. mi. of area above the lowest potential reservoir site is 17,540 acre-feet for the 46-year period from 1887 - 1933.

Telegraph Creek drains an area of eight sq. mi. between Sweetwater and Otay Rivers. The Creek rises southwest of San Miguel Mountains, and flows southwest through the outskirts of Chula Vista to enter the southern end of San Diego Bay.

Otay River originates in Lower Otay Lake and flows 13 miles west from Otay Dam to enter the southern end of San Diego Bay, 3.5 miles south of the mouth of Sweetwater River and 39.3 shore line miles north of the Mexican Border. The total drainage area is 144 sq. mi. The mean seasonal runoff for the 46-year period from 1887 to 1933 is 7,650 acre-feet for the 99-sq. mi. area above the lowest potential reservoir site.

Tia Juana River drains an area of 1,724 sq. mi.* of which only 460 sq. mi. are in the San Diego Basin, the remaining 1,264 sq. mi. being in Mexico. The River is formed by the confluence of Rio Las Palmas and Arroyo Matanuco just below the Rodriguez Dam in Mexico. The River flows 17 miles northwest to empty into the ocean at shore line mile 1.5 north of the Mexican Border and crossing the Border into the United States at river mile six from the mouth. Cottonwood Creek, the principal tributary, rises in the Laguna Mountains of San Diego County and crosses the Border into Mexico at its confluence with Rio de Tecate. The mean seasonal runoff for the 413 sq. mi. of drainage area in the United States above the lowest possible reservoir site on Cottonwood Creek in this country is estimated to have been 41,010 acre-feet during the 47-year period from 1887 to 1933.

Table 6 shows that of the 302,050 acre-feet of mean seasonal runoff for the Pacific slope of San Diego County, 232,360 acre-feet, or approximately 77 percent, is subject to control at the lowest potential reservoir sites. An additional 27,800 acre-feet or nine percent of the runoff is tributary to potential reservoirs in minor basins, and much of the remaining 14 percent is tributary to underground reservoirs near the coast and at least partially conservable.

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* The drainage area of the Tia Juana River, according to the International Boundary and Water Commission, is 1,724 square miles, of which 460 are in the United States (San Diego Basin) and 1,264 in Mexico. These figures are used throughout the report except where other authorities are quoted. The Department of the Army considers the total drainage area to be 1,680 square miles (Table 4, p. 13, appendix) and the California Department of Public Works, Division of Water Resources, states that its area within the U. S. is 461 square miles (Table 6, p. 15, appendix).

Table 7 (Appendix) taken from Table 49, Bulletin No. 1, Water Resources of California, State Water Resources Board, 1951, shows runoff data for the San Diego region from 1894-95 to 1946-47, during which period the seasonal mean runoff was 331,400.

Table 7 (Appendix) is probably more reliable than Table 6, as much of the earlier data were estimated for drainage areas which lacked gaging stations. Direct comparison of the two, for specific drainage areas, is impossible because the gaging stations for Table 6 are not specified.

Economic Development

Population - The population of the Basin is estimated to have been 36,000 in 1900, 114,900 in 1920, 293,900 in 1940 and 542,000 in 1950. These estimates were computed by assuming the 1940 percentage distributions of county populations comprising the Basin existed in 1900, 1920, and 1950, that is, 5.8 percent of Orange County, 2.9 percent of Riverside County, and 97.9 percent of San Diego County. The populations for 1940 were determined by summation of the census reports by minor civil divisions. (Table 8, Appendix)

The 84.4 percent increase in the Basin population from 293,900 in 1940 to 542,000 in 1950, as compared to an increase of 14.5 percent for the United States, has been partly due to the impact of World War II. Many Navy and other military personnel were stationed in the San Diego area during the war and many civilian workers migrated to the area to work in local war plants. Many of these new-comers have established homes in the area.

The 84.4 percent increase in the San Diego Basin population during the ten-year period as compared to the increase of 51.6 percent for the State of California also reflects the remarkable preference persons moving to the west coast have shown for Southern California. The increase of only 58 percent in population for the City of San Diego during the same period 1940 to 1950 may also indicate a preference for smaller communities and rural areas.

The population of the eight largest cities in the Basin was 240,362, or 82 percent of the Basin population in 1940, as compared to 406,698, or 75 percent of the population in 1950.

City	POPULATIONS 1940	1950	Percent Increase
San Diego	203,341	321,485	58
National City	10,344	21,132	104
Chula Vista	5,138	15,844	208
Oceanside	4,651	12,880	177
Coronado	6,932	12,423	79
La Mesa	3,925	10,908	178
Escondido	4,560	6,608	45
El Cajon	1,471	5,418	268
Total	240,362	406,698	
Basin	293,900	542,000	
Percent of Basin Population Represented by Eight Largest Cities	82	75	

Industry - The Basin has a unique economy based on industries, agriculture, Navy payrolls and tourist income. Much of its prosperity in recent years has been due to a phenomenal growth.

Aircraft production, tuna packing and ship building, in that order, led the industries in San Diego County in producing a $78,000,000 industrial payroll in 1949. Aircraft production has been moving ahead rapidly since 1949 at the four large aircraft firms, Convair, Solar, Rohr, and Ryan, and the dozens of smaller manufacturers who subcontract work on aircraft. All of the industrial activity with the exception of some food processing is concentrated in the San Diego metropolitan area.

The total labor force increased from 83,569 in 1940 to 144,065 in 1950. Total annual payrolls increased from $119,000,000 in 1939 to $388,000,000 in 1949 (Table 9, Appendix).

Agricultural production valued at $57,000,000 in 1948 and $62,000,000 in 1949 placed San Diego County twenty-second among the 3,069 counties in the United States in value of agricultural products. Animal husbandry products including poultry, dairy, and livestock lead in value followed by truck crops, citrus fruits and other fruits and nuts. The area is particularly noted for avocados and lemons, the Basin having a larger acreage of avocados than any other section of the world. Due to the practically frostless climate over much of the coastal area, many exotic semitropical fruits are grown, usually on an experimental basis by citrus and avocado growers. (Table 10, Appendix).

Although there are many large ranches, much of the agricultural production is from small farm homes of a few acres for which San Diego County is famous. The 1940 Federal Census showed 35 percent of the total area of the county devoted to farming. The total number of farms was 6,844 of which 70 percent were less than 50 acres.

The United States Navy payrolls are important in the economy of the Basin. The Navy's payrolls in 1949 included $55 million to active duty personnel and $42 million to civilians employed by the Navy in the San Diego area. Large amounts are also received by retired Navy personnel and dependents. Many Navy ships are based at San Diego and extensive training facilities are maintained in the area. These activities have been greatly increased since 1949.

Another important source of income in the Basin is the tourist trade. The San Diego Chamber of Commerce estimates tourists spent $54 million in San Diego County in 1949 and their expenditures resulted in direct employment for an estimated 7,500 persons. Since the San Diego area is famed as both a winter and summer resort, the tourist trade is a steady source of income.

The assessed valuations of incorporated cities in the Basin and of San Diego County are shown in the following table:*

Chula Vista	$13,454,210
Coronado	12,644,550
El Cajon	4,533,360
Escondido	5,679,760
La Mesa	9,574,750
National City	10,897,650
Oceanside	9,880,430
San Diego	311,586,940
San Diego County	492,108,730
- - - - - - - - - - - -	- - - - - - - - - - - -
Laguna Beach	15,500,000 **
San Clemente	4,529,000 **
Basin total	512,137,730

Assessed property values are at least 50 percent less than current market values.

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* Source - San Diego County Auditor and Controller, except those otherwise noted. (1950-51 figures)

**California State Chamber of Commerce, Research Dept., Economic Survey Series 1950-51 (1949-50 figures).

Land Use and Development

No data have been compiled on land use for the Basin area, so values for San Diego County are given instead. The Basin includes substantially all of the irrigated land and agricultural production in San Diego County and county values are fairly representative of the Basin. The small areas of Riverside and Orange counties included in the Basin are largely mountainous and contain little agricultural land.

The County Assessors' Office shows the following breakdown for the 2,725,120 acres (4,258 sq. mi.) of land area in San Diego County in 1949:

U.S.A. Military Lands, acquired before 1942	6,788	acres
U.S.A. Military Lands, acquired 1942 or later	165,339	"
Total	172,127	"
Federal Housing, Post Offices, etc.	3,209	"
Indian Reservations	110,036	"
State Parks (Desert, Mountain & Beach)	415,672	"
City and County Public Parks and Fee-Owned Lands	19,767	"
Cleveland National Forest	276,298	"
U.S.A. Public Domain	409,397	"
State School Lands and Privately-Owned Non-Taxable Lands	68,546	"
Total non-taxable lands in San Diego County	1,475,052	"
Total area of San Diego County: 4,258 sq.mi.	2,725,120	"
Percent of entire county in non-taxable land	54.1	

Almost all of the 172,127 acres of military land in the County are in the Basin. Although there are many military installations, two large camps, Pendleton with 131,126 acres and Elliot with 29,060 acres, account for most of the area.

The following table, compiled by the San Diego-California Club in cooperation with the County Agriculture Commissioner and the Agriculture Extension Service of the University of California, indicates the total land area devoted to farming in San Diego County has remained rather constant since 1920 although there is a trend toward smaller farms and an increase in the number of owner operated farms:

FARMS - NUMBER, ACREAGES, AND VALUES

	1949	1930	1920
Number of Farms	6,077	3,902	3,200
Acreage in Farms	917,562	833,336	925,192
Value-Land & Buildings	$96,651,000	$84,447,000	$55,918,847
Farms operated by Owner	4,892	3,207	2,419
Farms operated by Tenants	887	432	646
Farms operated by Managers	298	272	135

Of the 917,562 acres farmed in 1949, a total of 56,377 acres was irrigated and the remainder was dry farmed or used only for pasture. The area of arable land that could be irrigated if additional water supplies were available is variously estimated at from 100,000 to 360,000 acres. (Table 11, Appendix)

Lumber production is not an important industry in the Basin. In 1946 there were only seven active lumber mills in San Diego County. Total lumber production was 1,921 thousand board feet, mostly Ponderosa pine and white fir.

Mineral production is also relatively unimportant in the area, totaling $1,882,394 in 1947, $2,594,065 in 1948 and $2,427,135 in 1949. The most important products are sand, gravel, clay and stone. (Table 12, Appendix) The region contains some of the largest and best deposits of semi-precious stones in the state. Tourmaline and kunzite are especially important. There are no producing oil or gas fields in the Basin.

USES OF WATER RESOURCES

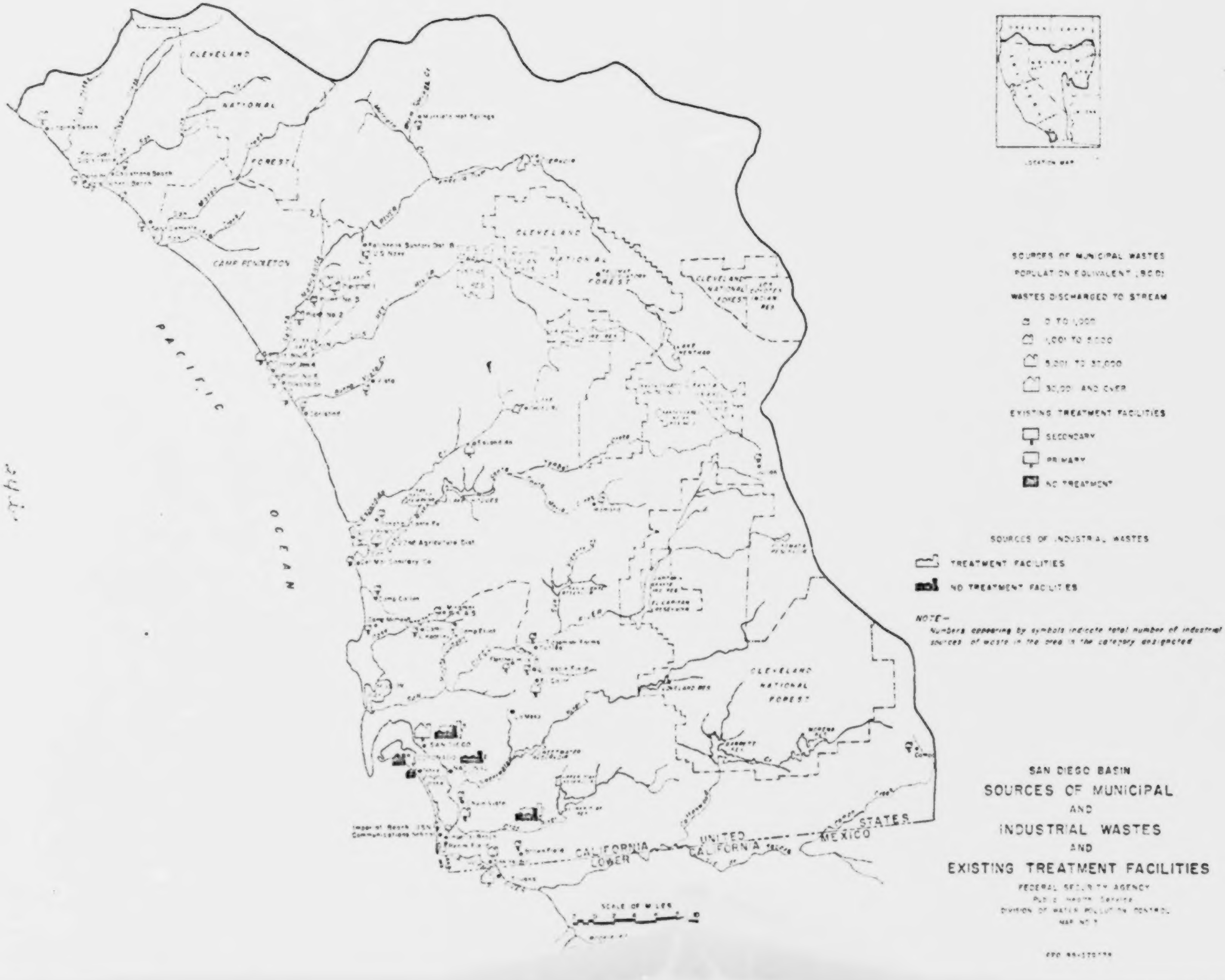
The San Diego Basin is located in a semiarid section of the United States where there is so little annual rianfall that the vegetation of urban and agricultural areas is dependent upon frequent irrigation. From the standpoint of natural water resources, the Basin is considered to be one of the poorest in California. This is due in part to the low and very erratic rainfall and in part to the small area and other characteristics of the watersheds which average only 45 miles in length and may all be subject at a given time to drought or periods of above-normal rainfall. (Map 2)

The Division of Water Resources in 1935 estimated the maximum safe yield of the major streams in the Basin, by surface and ground water storage, to be 161,570 acre-feet per year. (Table 13, Appendix) This table does not include the runoff from that part of the Tia Juana River lying in Mexico or of San Juan Creek and other smaller drainage areas in the Orange County portion of the Basin. The estimated safe yield is based on a mean seasonal runoff of 302,050 acre-feet as shown in Table 6 for the period from 1887 to 1933. No safe yield estimate is available based on the mean seasonal runoff of 331,400 acre-feet for the period from 1894 to 1947 shown in Table 7.

The basic problem of obtaining adequate water supplies from local sources of the San Diego Basin is shown very clearly in Tables 14 and 15, (Appendix). Table 14 lists the estimated seasonal natural runoff by years for the period from 1894-95 to 1946-47 for five of the principal streams in the Basin. This table shows that, for the San Diego River, the annual runoff varied from 980 acre-feet in 1899-1900 to 352,000 acre-feet in 1915-16. Based on the average annual runoff of 52,200 acre-feet for the 53-year period, the annual runoff has varied from less than two percent to 674 percent of the annual average. The runoffs from the other streams show similar variation.

Table 15 shows the mean seasonal full natural runoff of the major San Diego County streams for selected periods of the 46 years of record from 1887 to 1933. Using the 46-year mean of 222,620 acre-feet of runoff for these streams as a basis for comparison, the nine drought years from 1895 to 1904 show a mean annual runoff of 41,720 acre-feet or only 19 percent of the 46-year mean. Even more significant, the mean for the 19 dry years from 1895-1914 was only 125,790 or 57 percent of the 46-year mean while the mean for the 19 wet years from 1914-1933 was 290,690 acre-feet or 131 percent of the 46-year mean.

Because of the extreme variability of runoff in the San Diego Basin, engineers of the United States Geological Survey believe that too much emphasis should not be attached to the mean seasonal runoff. They believe that of far greater significance is the median seasonal runoff, a value placing relatively less emphasis on the few unusually wet years which account for much of the total runoff. Using the Sweetwater River drainage area as an example, 15 percent of all the


LOCATION MAP
SOURCES OF MUNICIPAL WASTES
POPULATION EQUIVALENT (BOD)
WASTES DISCHARGED TO STREAM
0 TO 1,000
1,001 TO 5,000
5,001 TO 30,000
30,001 AND OVER
EXISTING TREATMENT FACILITIES
SECONDARY
PRIMARY
NO TREATMENT
SOURCES OF INDUSTRIAL WASTES
TREATMENT FACILITIES
NO TREATMENT FACILITIES
NOTE—
Numbers appearing by symbols indicate total number of industrial sources of waste in the area in the category designated
CLEVELAND NATIONAL FOREST
CAMP PENDLETON
PACIFIC OCEAN
SAN DIEGO
UNITED STATES
MEXICO
CALIFORNIA
LOWER CALIFORNIA
SCALE OF MILES

SAN DIEGO BASIN
SOURCES OF MUNICIPAL
AND
INDUSTRIAL WASTES
AND
EXISTING TREATMENT FACILITIES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 7

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runoff between 1887 to 1949 occurred in the single year 1915-16, and 27 percent occurred in the two years 1915-16 and 1926-27. In this same 62-year period of record 53 percent of all the runoff occurred in six years. The median seasonal runoff of 6,220 acre-feet for this drainage area, or only 35 percent of the mean seasonal runoff of 17,540 acre-feet, is believed to be a closer estimate of the safe yield than the 60 percent value shown in Table 13. The median values for the five major streams in the Basin are shown in Table 14. No direct comparison between these values and the estimated safe yields shown in Table 13 can be made as they do not cover the same periods of time or the same gaging stations.

In connection with conservation and utilization of the available water supply, probably the relatively large evaporation from surface reservoirs is next in importance to the normal runoff from drainage areas in the Basin. The mean seasonal gross evaporation from existing reservoirs in the region varies from 55 to 73 inches and increases directly with distance from the coast and with increase in elevation. This is no doubt due to the moderating effect of the ocean lowering summer temperatures and increasing humidity near the coast. Reservoirs near the crest of mountains are apparently more exposed to the dry hot desert winds. A great deal of study has been made of the possibilities of reducing evaporation losses through careful location and operation of surface reservoirs in the region.

The San Diego County Water Authority* estimates the present average water use in San Diego County totals approximately 160,000 acre-feet annually. This value should also be a fair approximation of water use in the Basin assuming the water use in the area of San Diego County outside the Basin is roughly equal to the water use of the small portion of Orange and Riverside Counties in the Basin.

Community water supply and irrigated agriculture are the two most important water uses in the area.

Table 16 (Appendix) summarizes the water supply information for 21 public water supply systems in the Basin. The population served by these supplies is estimated at 553,000, slightly higher than the population of 542,000 estimated for the Basin. The lower value is based on 1950 census figures. The higher one is based on surveys made in 1951 and reflects the increase in population due to the influx of Military Personnel.

The estimated water consumption indicated in Table 16 varies from a minimum of 87.24 M.G.D. to a maximum of 162.34 M.G.D. On the assumption that the minimum value represents the average domestic consumption, the total supply for domestic use would be 97,700 acre-feet per year. This total no doubt includes some irrigation use as San Diego County has many small farms and ranches depending upon a single water supply for both domestic and irrigation use.

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* See Appendix for a complete report of the water resources in San Diego County by the San Diego County Water Authority.

Assuming the total acreage irrigated to be 56,377 (Table 11, Appendix), and the average duty to be 1.3 acre-feet per acre*, the total water use for irrigated agriculture would be 73,290 acre-feet per year.

These two major water uses account for substantially all of the water use in the Basin. Other uses such as industrial water supply and cooling are relatively minor and are included in the domestic consumption.

During normal years, approximately 115,000 acre-feet of water is available from local stream diversions, surface reservoirs, and wells. During the present period of subnormal rainfall, much less water has been available. As of May 1, 1951, the reservoirs of the San Diego County Water Authority Agencies had only 77,260 acre-feet of water in storage or approximately 17 percent of their combined capacity.

The San Diego Aqueduct was operated continuously at full capacity during the period July 1, 1949 to June 30, 1950, delivering 69,264 acre-feet of Colorado River water as compared to 71,570 acre-feet during the previous year. There was no measured runoff from drainage basins serving the Authority Agencies during the 1949-50 season and the water needs of the Agency members had to be met by imported Colorado River water, supplemented by local water taken from storage in reservoirs and ground water basins. The continued reduction in water reserves has created a hazardous situation in the water supply of Authority Members, which could become critical if the drought continues for more than another year or if mobilization should impose an abnormal increase in water use.

Future development of additional local water resources is possible on most of the major streams of the Basin, but the least costly and most conveniently located reservoir sites have already been developed. Further reservoir construction will become increasingly costly per acre-foot of added yield. Table 7, of the Authority Report (Appendix), shows the various possible projects with the indicated yield and cost. The maximum additional firm yield which can be expected from further development of local surface supplies in the Basin is apparently between 25,000 and 35,000 acre-feet, not counting the Santa Margarita River where the Navy Department faces an unknown demand for military use, and the lower Tia Juana River where a water conservation project may be developed at a reservoir site located on or near the international boundary between the United States and Mexico under the terms of the 1944 Water Treaty between the two countries.

Even though admittedly some of the local water resources have not yet been fully developed, it should not be inferred that the Basin has been negligent in developing its own water resources before importing water from outside the area. Table 17 (Appendix) lists 29 reservoirs, constructed by San Diego County interests, with a combined capacity of 697,161 acre-feet. This storage exceeds 230 percent of the County mean annual runoff of 302,050 acre-feet, and is more than double that of the entire Basin, 331,400 acre-feet. By comparison, the San Joaquin River Basin which is also a water deficient area has constructed 2,716,270 acre-feet of storage or only 36 percent of the mean annual runoff of approximately 7,500,000 acre-feet.

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* Corps of Engineers, U.S. Army - Report on Preliminary Examination Flood Control all Streams in San Diego County, California, Flowing into the Pacific Ocean (1943).

The ground water basins in the Basin are not extensive and have already been overdeveloped in some instances. The city of Oceanside, the Fallbrook Public Utility District, and the Lakeside Irrigation District obtain all their supplies from wells, and other Authority Agencies augment their surface supplies from underground sources as required. The normal safe yield is estimated at 8,000 acre-feet per year. The water levels in the well fields are now below normal, however, and the city of San Diego has drawn no water from its wells for several years. In addition to the 8,000 acre-feet of ground water normally used by Authority Agencies, it is estimated that 15,000 acres of river-bottom land are irrigated by individual land owners having riparian rights.* Assuming a duty of 1.3 acre-feet per acre, private water use averages 19,500 acre-feet per year. part of which is ground water.

The San Diego Aqueduct, designed by the Bureau of Reclamation and built by the Navy (1945 to 1947) as part of the War effort, is now supplying 70,000 acre-feet or 44 percent of the 160,000 acre-feet present annual water use in the Basin. The most optimistic estimates for the immediate future development are 25,000 acre-feet additional from local sources and 50,000 acre-feet additional from the Colorado River by completion of the second barrel of the San Diego Aqueduct.** The Authority estimates the total potential water supply of the Basin at approximately 260,000 acre-feet, including 115,000 from reservoirs and wells, 70,000 from the present aqueduct, 50,000 from the second barrel, and 25,000 from development of additional local surface reservoirs.

The present supply of 185,000 acre-feet (actually less than 160,000 acre-feet under drought conditions) supports a population of 542,000 and permits irrigation of 56,377 acres of land. The additional arable land that could be developed by irrigation in the Basin is variously estimated at from 100,000 to 360,000 acres. The potential 75,000 acre-feet increase in water supply would permit irrigation of only an additional 58,000 acres. The expected increase in population will affect the situation only to the extent that non-arable lands are subdivided. Where land under irrigation is subdivided into residential areas, the water use does not ordinarily increase.

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* Report on Water Resources by San Diego County Water Authority (Appendix)

**See the Authority Report for information on the proposed second barrel (Appendix).

It is clear that even with construction of the second barrel of the San Diego Aqueduct and development of all local water resources there will still be insufficient water available to permit full development of the resources of the Basin. Land presently not under irrigation is potentially some of the highest value agricultural land in the United States. Conversations with the Bureau of Agricultural Economics, U. S. Department of Agriculture, indicate that there are thousands of acres of land upon which, given water, avocados and other high value crops could be grown. Good avocado land is presently valued at from $1,700 to $2,000 per acre in the rough.

The waters of the Basin are extensively used for commercial and sport fishing.*

The principal ports used for commercial fish landings are San Diego and Point Loma. In 1949, the fish landings for the area totalled over 200 million pounds (valued at about 32 million dollars) and the commercial fishing fleet for the 1949-50 season, manned by about 3,200 licensed fishermen included 946 boats, i.e. about 15 percent of the State total. The tuna catches comprised about 85 percent of the regional total while the landings of sardines, spiny lobsters, barracuda, and Pacific mackerel ranked next in order of weight.

Saltwater sport fishermen operate along over 100 miles of coast, principally from the ports of San Diego, Oceanside, and San Clemente. Their catches include kelp bass and sand bass, ocean whitefish, rockfish, kingfish, albacore, yellow tail, marlin and barracuda. In 1949, the number of "party" boats employed in the fishery exceeded 800. Over 100,000 yellow tail were brought into San Diego Bay by sport fishermen in 1949. The annual yellow tail derby, which offers $10,000 in prizes for the largest fish caught, has attracted nation-wide interest. Small clam beds in the southern part of San Diego Bay provide bait for sport fishermen.

In normal years the storage reservoirs provide good fishing for warm water varieties, such as bass, bluegill, crappie and catfish. The reservoirs that are open to public fishing attract thousands of anglers each year from all parts of California. At present, drought conditions have necessitated the closure of the following reservoirs to public fishing: El Capitan, Loveland, San Dieguito, Lake Cuyamaca, Lake Henshaw and Sweetwater.

During 1948, approximately 42,000 sport fishermen used the inland waters to catch nearly 2,000,000 sunfish, and around 33,000 fishermen caught about 500,000 black bass. Trout, crappie and catfish are additional, important sport fish.

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* Statistical records given here are based on data of the California Department of Fish and Game for the San Diego Region which area corresponds closely to that of the San Diego Basin, also, additional fisheries data have been generously provided by this Department.

The shore line of the Basin is the scene of extensive recreational activity including boating, swimming, water skiing, surf boarding, and picnicking by residents of distant places as well as those within the Basin. Many people live aboard boats anchored in the numerous small boat harbors. Superior travel facilities and climatic conditions assure continuous use of the valuable coastal recreational attractions during all months of the year.

National Forests and other watershed areas have some recreational use, but this is curtailed, during the dry season, by rigidly enforced fire prevention measures.

POLLUTION CONTRIBUTED TO WATER RESOURCES

There are 45 sewered communities, as enumerated in Table 1, Appendix, discharging wastes with a population equivalent of approximately 366,000 to the water resources of the Basin. Of this total, wastes with a population equivalent of 11,200 are discharged to streams or dry watercourses, wastes with a population equivalent of 1,500 are discharged to land, and wastes with a population equivalent of 353,300 are discharged to the ocean or tidal waters. (Table A, page 31; Map 3)

The wastes being disposed of to watercourses are discharged from 12 communities scattered throughout the Basin as follows: Brown Field and Campo to the Tia Juana River basin; El Cajon and Camp Elliot to the San Diego River basin; Camp Miramar (two plants) and Camp Mathews to Rose Canyon; Camp Callan to Soledad Creek; Escondido to Escondido Creek; Vista Sanitation District to Buena Vista Creek; and Murrieta Hot Springs, Fallbrook S. D. and U. S. Navy, and Camp Pendleton (three plants) to the Santa Margarita River basin. All of the waste discharges are comparatively small, the largest having a population equivalent of 3,100 from El Cajon. (Table 1, Appendix)

Wastes are being discharged from eight communities to land disposal systems, either prepared percolation beds or sewage farms. The eight communities are also widely scattered, San Clemente being near the coast, Edgemoor Farms, Julian S. D., Gillespie Field, and Fletcher Hills S. D. in the San Diego River basin, Rancho Santa Fe and Ramona S. D. in the San Dieguito River basin and San Juan Capistrano S. D. in the San Juan Creek basin. These discharges are all small, the largest having a population equivalent of 600 from Fletcher Hills S. D.

Wastes from municipal sewerage systems are discharged to the Pacific Ocean or tidal waters from the 26 communities along the coast. Ten of these communities in the San Diego Metropolitan area, Coronado, Naval Amphibious Base, Chula Vista (two plants), North Island Naval Air Station, National City, La Mesa, Lemon Grove, Rolando, San Diego State College and San Diego discharge wastes with a total population equivalent of approximately 299,700 to San Diego Bay.

The second largest waste discharge to the ocean is from the two communities, Tijuana and San Ysidro at a point 0.7 miles north of the Mexico-United States Boundary where wastes with a population equivalent of 27,700 are discharged.

Three communities -- Ream Field, Imperial Beach, and the U. S. Navy Communications School -- discharge wastes with a population equivalent of approximately 380 to salt sloughs at the mouth of the Tia Juana River.

The remaining 11 communities - Del Mar Sanitary Co., 22nd Agriculture District, Solano Beach, Carlsbad, Oceanside, Camp Pendleton (three plants to the ocean and three plants previously mentioned to watercourse), Capistrano Beach Land Co., Capistrano Beach S. D., Doheny

TABLE A
SOURCES OF WASTE DISCHARGE
MUNICIPAL

Municipalities 1/	Sources of Waste Discharge (In Number of Municipalities) 1/	Population Served by Sewerage System	Amount of Waste Discharged to Watercourse (In Terms of Equivalent Number of People) 2/
Having data on waste load discharged to watercourse	45	562,235	11,200 - to watercourse 1,500 3/ - to land 353,300 - to ocean 366,000
Total	45	562,235 4/	366,000

1/ Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.
2/ Includes industrial wastes discharged into municipal sewerage systems.
3/ Includes wastes with a population equivalent of 300 discharged to the ocean when not required for irrigation.
4/ Industrial wastes with a population equivalent of 79,540 discharged to municipal sewer systems increases the population equivalent of municipal wastes to 641,775, before treatment.

TABLE B
SOURCES OF WASTE DISCHARGE
INDUSTRIAL 1/

Industries 1/	Sources of Waste Discharge (In Number of Plants)	Amount of Waste Discharged to Watercourse (In terms of Equivalent Number of People)
Producing Organic Wastes	7 2/	145,000
Producing Organic Wastes	5	Undetermined
Producing Inorganic Wastes	1	Not Applicable
Producing Wastes of Undetermined Type	0	Undetermined
Total	12 3/	xxxxxx

1/ Industries having separate outlets discharging wastes directly to watercourse.
2/ Includes 1 plant also producing inorganic wastes.
3/ Total adjusted to correct for duplication noted in footnote 2/.

Beach State Park, Dana Point Sewer Maintenance Dist., and Laguna Beach are dotted along the coast for a distance of 150 shore line miles north of the Mexico-United States Border. The total population equivalent of wastes discharged by the 11 widely separated communities is approximately 25,500. Oceanside with a population equivalent of 7,700 has the largest discharge of the eleven.

In addition to discharges to the Bay from the ten sewered communities of the San Diego Metropolitan area, wastes are discharged from small industries, business places and offices located along the water front between the municipal piers and 28th Street; from minor areas of U. S. Navy shore installations; and from a "floating" population aboard naval ships.

In addition to the 45 sewered communities, there are 12 known industries discharging wastes through industrial sewer systems with separate outlets. Seven of these industries discharge organic wastes with an estimated population equivalent of 145,000 to San Diego Bay. The population equivalents of wastes from the remaining five plants are undetermined. One of the plants discharging organic wastes to the Bay also discharges inorganic wastes. (Table B, page 31)

Industrial wastes being discharged to the Bay come from tuna boats and tuna canneries, a meat and fish waste reduction plant, a kelp processing company, a soap company, and airplane manufacturing plants.

Table 2 (Appendix) shows that approximately 50 percent of the known organic industrial waste load being discharged to the Bay was produced by kelp processing works, approximately 35 percent was produced by the tuna canning industry and 14 percent by rendering works.*

Kelp processing works recover algin by digesting kelp with sodium carbonate and filtering with diatomaceous earth as a filter aid. From six to eight tons of spent kelp and 12 to 16 tons of filter aid as well as spent chemicals are discharged to the Bay daily.

The wastes coming from the tuna canning industry are principally from three sources, the fish wells of the tuna boats, the fluming and thaw tanks, and the cutting room and other in plant operations. Sea water is ordinarily used for all thawing, fluming, and cleaning operations except in the actual canning process. It is estimated that approximately 75 percent of the wastes from the tuna canning industry are brine wastes and only 25 percent fresh water wastes. There are five tuna canneries in operation at present, four adjacent plants located between Crosby and 28th Streets, and one located near Point Loma. There is one additional tuna cannery under construction.

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* San Diego Bay Investigation (52-9-1) of the San Diego Regional Water Pollution Control Board being conducted in part under contract with the Bureau of Sanitary Engineering.

Rendering works produce stock feed, fish oils, and grease from fish and meat scraps and sardines. The wastes from the plant include condensate and cooling water from evaporators, wash down water from centrifuges, separators, and yards, water from the fumes washer and wastes from cattle entrail processing. Sea water is used in the entrail washing process making the saline content of the wastes very high.

Inorganic wastes are known to be discharged to the Bay from kelp works. The location and amounts of other inorganic waste discharges have not been determined, but it is believed that such discharges are relatively small. Surveys are being continued at all potential sources to determine possible pollutional effects in this regard.

Only one meat packing plant, located in National City, discharges wastes to the Bay. Between 600 and 800 cattle are processed per month. Wastes are discharged to the shallow tidal slough of Paradise Creek about 300 yeards from the Bay shores. Table 2 shows this is being corrected.

The two main refuse dumps in the San Diego area are "Murray Canyon" located at the extreme end of east fork of Murray Canyon and serving approximately 45 percent of the total population, and "Chollas Heights" located a quarter of a mile southwest of Chollas Reservoir and serving approximately 40 percent of the population. There are two smaller dumps, "La Jolla" located 0.6 mi. south of the intersection of Coast Highway and Torrey Pines Rd., and "Brandywine" located 0.75 mi. east of the Coast Highway and Balboa Avenue. All of the dumps except "Brandywine" are owned and operated by the city and all are well located with respect to possible ground or surface water pollution.

There are several possible sources of pollution in the Otay River basin near the south end of San Diego Bay, from rendering plants and hog ranches, which are under study.

There is little industrial activity in the Basin outside the San Diego Metropolitan area except in the Escondido area where there are a few wineries and food processing plants. The food processing plants are all believed to be connected to the Escondido Municipal sewerage system. As far as is known at present, none of the wineries discharge wastes to watercourses.

Marketable citrus fruit is packed for shipment at several packing plants in the Basin. Wash water discharges from these plants present a potential pollution problem due to the use of boron compounds in the washing operation. If the waste water is discharged to land disposal fields or dry creek beds, it may percolate to the underground storage basins increasing the boron content of the ground water. Irrigation water containing boron in quantities as low as 0.5 p.p.m. may be harmful to a large group of boron sensitive crops including lemons, grapefruit, oranges, and avocados.

Pollution from uncontrolled recreational use of watershed areas could become a threat to the quality of surface waters in the Basin.

Sediment from eroding watershed lands is also a serious pollutant in the San Diego Basin. The following table*, showing the amount of sediment that has been deposited in three representative reservoirs, gives an indication of the silting problem in the Basin.

Reservoir	Period	Volume of Sediment Deposited
Sweetwater	1887 - 1948	8,679 acre-feet
Morena	1910 - 1948	7,834 "
Hodges	1919 - 1948	3,119 "

* Provided by the U. S. Department of Agriculture, Soil Conservation Service.

DAMAGES TO WATER RESOURCES FROM POLLUTION

Since the population equivalent of all known wastes discharged to surface streams or watercourses is only 11,400 or approximately three percent of the total waste discharges from the Basin, not much damage to surface waters would be expected from waste discharges. A nuisance condition has apparently existed at times in Forrester Creek below the El Cajon municipal treatment plant outlet, and in the San Luis Rey River below the outlets from Camp Pendleton plants No. 1 and 2, the effluents from both of which have recently been diverted to the Santa Margarita River basin.

There is also little evidence of damage to ground water from waste discharges. Wastes with a population equivalent of only 1,500 are ordinarily disposed of to land. There is definite evidence of sea water intrusion into the seaward margin of some of the major valleys.* In the Tia Juana Valley, the ground water level elevation near the coast is below sea level, and the landward hydraulic gradient slopes inland from the coast for a distance of from one to three miles. The water rights of ground water users in this area are now being adjudicated in an effort to reduce the overdraft.

In the Otay Valley the ground water level near the coast is approximately one foot below sea level. The data available show no evidence of intrusion.

In the San Diego Valley, salt water encroached into the Old Town pumping field near Mission Bay about 1906 resulting in abandonment of the field. The maximum inland distance of intrusion is approximately one mile, but the length of coast line encroached and the total area underlain by salt water have not been determined.

In the San Luis Rey Valley, evidence of sea water intrusion was first noted in 1938. The maximum inland distance of intrusion was three miles in 1950.

There is also definite evidence of intrusion in the Santa Margarita Valley extending three miles inland from the coast in 1950.

Approximately 97 percent, on a population equivalent basis, of the domestic and industrial wastes discharged from the San Diego Basin are disposed of to the ocean or tidal waters, where the greatest damage to the waters of the Basin occurs.

The State and San Diego County Health Departments have received complaints from the public of damage to beaches and recreational areas in the vicinities of many of the points of waste discharge.

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* Sea-Water Intrusion into Ground Water Basins Bordering the California Coast and Inland Bays, Calif. State Department of Public Works, Division of Water Resources, December 1950.

At the Tijuana-San Ysidro ocean outfall, located 0.7 mi. north of the Mexico-United States Border, excessive amounts of grease and other sewage solids are at times apparent along the beach within 500 feet north and south of the point of discharge. Samples of ocean water collected in the vicinity of the outfall have also shown coliform indices exceeding the standards for salt water bathing areas established by the State Department of Public Health. The U. S. Navy controls the beach area in the vicinity of the outfall, and the area is not open to the public. Recent surveys have indicated the zone of high coliform concentration may, at certain seasons of the year, extend north as much as two miles to the public beaches in the vicinity of Imperial Beach.

Waste discharges from the three communities, Ream Field, Imperial Beach, and the U. S. Navy Communications School, to salt sloughs at the mouth of the Tia Juana River probably do not aggravate the beach pollution problem at present as the salt sloughs are normally landlocked by sand bars across the mouth of the river. Property values may be adversely affected by the waste discharges. This area is being rapidly developed for residential purposes.

An investigation of San Diego Bay was started in 1951 by the State Department of Public Health, Bureau of Sanitary Engineering. The survey is being made at the request of the San Diego Regional Water Pollution Control Board to determine the effect and extent of domestic and industrial waste discharges to San Diego Bay.

Preliminary reports of the investigation indicate that during March 1951, dissolved oxygen values in the middle harbor area, extending from the San Diego-Coronado ferry crossing south almost to the destroyer repair base, varied from 55 to 83 percent of saturation, and that coliform counts were uniformly 70 or 70 plus per ml. at the upper limit of the dilution used. The lowest dissolved oxygen concentrations found were 2.2 p.p.m. in the Chollas Creek Channel and 3.0 p.p.m. in the Beardsby Street industrial area. Although no sulfides were detected, bottom muds were noticeably black and characteristic of sewage sludge in some areas, and occasional gas bubbles were observed near the shoreline in the Beardsby Street industrial area.

Studies made by the Scripps Institute of Oceanography have shown an appreciable decline in the numbers of all types of fish once found in abundance in San Diego Bay. The Bay is a natural nursery ground for the breeding of game fish caught in the off-shore waters as well as for bait fish used by commercial and sport fishermen. The decline may be due in part to deposits of organic and inorganic material destroying bottom grasses which provide a natural habitat for young fish or to the presence of small amounts of highly toxic chemical wastes.

On infrequent occasions large numbers of fish have died in the forebays to cooling water pumps for the Silver Gate plant of the San Diego Gas and Electric Company. Cause of death has never been determined.

In addition to possible loss of fish and aquatic life, there has been damage to beach areas, particularly between the Coronado sewer outfall at the foot of Alameda Blvd. and the San Diego-Coronado ferry landing. Bacterial samples collected by the Bureau of Sanitary Engineering along this beach in December, 1950, showed the shore waters to be heavily contaminated. Grease balls and fecal material along this stretch of beach as well as stretches of the north shore make them unattractive for recreational use.

Samples of Bay water collected during the December 1950 survey, mentioned above, also showed high bacterial counts near the San Diego Rowing Club and at the Silver Strand State Park swimming area.

A considerable portion of the cannery water front is discolored and unsightly from wastes containing grease and oils.

North of San Diego Bay, wastes are being discharged to the ocean or tidal waters at 13 widely separated points along the coast of the Basin. None of these waste discharges is large enough to adversely affect large areas, but beaches in the immediate vicinity of certain of the discharges have been damaged to some extent when treatment facilities of rapidly growing communities have become inadequate. Since the beaches are the principal attraction to the great number of tourists who annually visit the Basin, damage of even small areas to the extent that they are unattractive to bathers or actually quarantined as a health hazard can be a serious economic loss to the community.

In November, 1950, the State Bureau of Sanitary Engineering and the State Division of Laboratories conducted a survey of the bathing waters and beaches in the Oceanside-Carlsbad area. The bacterial examinations showed that, at several stations in the vicinity of the 2,300 foot long ocean outfall for the Oceanside treatment plant and the 900 foot long ocean outfall for the Carlsbad Sanitary District treatment plant, the most probable number of coliform organisms exceeded ten per ml. in from 25 to 39 percent of the samples. It is significant to note, however, that during the off-bathing season when this survey was made, the City of Oceanside was not chlorinating its sewage treatment plant effluent and, further, that, subsequent to the survey, a break in the Oceanside outfall only 300 feet off-shore, and since repaired, was discovered. There was also some evidence of sewage debris on beaches in the Carlsbad area.

Sediment carried by streams increases the cost of water treatment and, by destroying fish feeding and spawning grounds, decreases the fish population. Reservoirs, too, are damaged by sediment, which settles in them and reduces their capacity, thereby curtailing the recovery of runoff.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

Perhaps the greatest benefit that has resulted from pollution prevention and abatement in the Basin is the protection of the limited but extremely valuable water resources. None of the surface waters of the area are lost to the highest possible beneficial uses from the effects of pollution by domestic or industrial wastes. A small percentage of the municipal wastes is actually being reclaimed for beneficial uses. Eight communities regularly use treated effluents for direct irrigation of field crops or recharge of ground water basins. In addition thirteen communities discharge treated effluents to watercourses that are ordinarily dry so that the effluent percolates to ground water basins before reaching the coast. Assuming a sewage flow of 80 gallons per capita for the combined population -- 61,430 -- of the 21 communities, the total amount of sewage reclaimed would be approximately 5,500 acre-feet per year.

Also of great importance is the protection of beaches and recreational facilities. Collection and treatment of wastes from the sewered population of approximately 500,000 living along the coast has protected most of the valuable beaches from pollution. The famous beaches of the Basin are the chief attraction for tourists; so maintenance of the beaches in a safe and attractive condition is the basis of the $54 million tourist industry.

Although surveys now being made of San Diego Bay indicate unsatisfactory conditions in some places, with dissolved oxygen content of the water in the middle harbor as low as 3.0 p.p.m., conditions were worse a few years ago and would be much worse now if much of the domestic and industrial wastes formerly discharged raw to the Bay were not collected and given primary treatment before discharge.

A survey made by the San Diego City Health Department in the early years of World War II indicated the Bay had become contaminated to a serious degree by wastes from the rapdily increasing population and expanding industries being discharged from numerous collecting sewers directly to the Bay. Although there is still some damage to the Bay from waste discharges, conditions would obviously be intolerable if sewage from ten communities with a combined population of 425,000 and industrial wastes with a population equivalent of 145,000 were not collected and treated before discharge to the Bay.

If these wastes were not given primary treatment, reducing the oxygen demand by approximately 40 percent, the dissolved oxygen content of water in much of the middle harbor could be completely depleted. The economic loss resulting from death of fish from lack of dissolved oxygen, damage to paint from hydrogen sulphide, and depreciation of property values from odor nuisance would be enormous.

The tangible benefits ordinarily realized from pollution prevention and abatement include reduced operating costs at municipal and industrial water treatment plants, increased sport and commercial fishery catches, reduction in travel costs to distant recreational areas, and increased water front property values.

The intangible benefits, although more difficult to evaluate, may be even more important than those benefits for which a monetary value can be determined. Promotion of public health, prevention of nuisance, provision of recreational facilities, and enhancement of the general welfare all tend to bring about a greater enjoyment of living, a longer, fuller life and increased productivity.

POLLUTION PREVENTION MEASURES IN EFFECT

Table C, page 41, indicates 43 communities in the Basin have constructed 44 waste treatment plants serving a population of 547,635. A total of 25 of these communities have 22 primary plants serving a population of 463,790 and 20 have 22 secondary plants serving a population of 83,845. Two communities have both primary and secondary treatment plants. There are only two communities in the Basin, Coronado with a population of 13,000 and the Naval Amphibious Base at Coronado with a population of 1,600, that have provided no treatment for their wastes. Two communities, Tijuana and San Ysidro, are included with those having primary treatment although the treatment provided is minor. Tijuana has an old septic tank that is so overloaded it is believed to be ineffective, and San Ysidro has comminution and chlorination only. (Map 3)

Six communities, National City, La Mesa, Lemon Grove, Rolando, North Island Naval Air Station, and San Diego State College all discharge their wastes to the San Diego Municipal system for treatment. Camp Miramar has two primary plants, Chula Vista has one primary and one intermediate plant, and Camp Pendleton has three primary and three secondary plants.

On the basis of average performance, the 44 treatment plants reduce the wastes of the 45 communities from a population equivalent of 641,775, including industrial wastes discharged to community sewer systems, to a population equivalent of 366,000, a reduction of 43 percent in five-day biochemical oxygen demand.

In addition to sedimentation and biological treatment designed to remove grease and other unsightly floating material as well as oxygen consuming organic solids, 25 communities, with a population of 137,610, regularly chlorinate their treated effluents to destroy disease producing organisms which may be present. In addition to regular treatment, eight of the communities have provided land disposal, either prepared percolation beds or sewage farms, so that none of their treated effluent reaches watercourses.

Table D, page 41, indicates six of the known industries with separate waste discharges in the Basin have treatment facilities and six have no treatment. Five of the treatment plants provide screening only or other minor treatment, and one provides primary treatment.

Table E, page 43, indicates 27 of the existing municipal treatment plants in the Basin are "adequate" as to capacity and degree of treatment provided. "Adequacy", as used here, indicates discharges from these facilities classified as satisfactory have caused no complaints and appear, on the basis of preliminary investigations, to be satisfactory for present conditions. In most cases, however, no special surveys have been made or hearings held as required by California law to determine legally whether "pollution" or "nuisance" is existing or threatened. Seven of the existing municipal facilities are considered as unsatisfactory on the basis of present information and the adequacy of ten is undetermined.

TABLE C
EXISTING TREATMENT FACILITIES
MUNICIPAL

Degree of Treatment Provided	Number of Municipalities 1/ Served	Number of Treatment Plants	Population Served
Primary	25	22 2/	463,790
Secondary	20	22 3/	83,845
No Treatment	2		14,600
Total	45 4/	44	562,235

1/ Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.
2/ Includes two minor treatment plants.
3/ Includes one intermediate treatment plant.
4/ Two municipalities have both primary and secondary plants.

TABLE D
EXISTING TREATMENT FACILITIES
INDUSTRIAL 1/

Type Industry	Number of Plants	Number of Industrial Plants Having:		
		Treatment Facilities	No Treatment Facilities	Undetermined Facilities
Food and kindred Products	12	6 2/	6	0

1/ Industries having separate outlets discharging wastes directly to watercourse or land disposal area.
2/ One provides primary treatment; the other five, screening only.

Table F, page 43, indicates one of the industrial waste treatment plants is "adequate", four are unsatisfactory, and the "adequacy" of one is undetermined.

Table G, page 43, shows communities in the Basin have been quite active in the construction of waste treatment facilities during recent years. Escondido constructed a plant in 1948 with a design capacity of 8,000, five communities - Ramona, San Clemente, Solano Beach, Oceanside, and San Diego - completed plants in 1950 with a total design capacity of 517,250, and San Ysidro and Imperial Beach are completing plants in 1951 with a design capacity of 3,200.

The San Diego plant completed in 1950 with a design capacity of 500,000 is by far the largest waste treatment plant in the Basin. In 1943 the City of San Diego completed a sewerage system to collect and treat the city sewage formerly discharged raw to the Bay. In 1950 the new and enlarged plant was completed to treat the sewage from the City of San Diego, which includes La Jolla, Pacific Beach, and Linda Vista, as well as the communities of La Mesa, National City, Lemon Grove, Rolando, San Diego State College, North Island Naval Air Station and other Naval installations in the Bay area.

Sewage treatment at the San Diego plant includes screening, pre-aeration, and sedimentation with separate sludge digestion. The outfall sewer discharges into the middle harbor at a depth of about 30 feet at the pier head line adjacent to pier No. 5 of the Naval Station.

One new industrial waste treatment plant was constructed in 1951, and several industries made connection to municipal systems so they no longer have separate waste discharges. The new industrial waste plant was built jointly by the Wright Packing Co. and the Hoskins Packing Co. to pretreat packing plant wastes before discharge to the San Diego sewerage system. The Hoskins plant has already been connected to the new pretreatment plant and city sewer system and the Wright plant will be connected in 1951.

Much of the recent construction in the water pollution control field in the San Diego Basin has been stimulated by two Acts, known as Chapter 47 and Chapter 20, passed by the California State Legislature to help develop a postwar construction program of needed public works.

Chapter 47, which became effective September 12, 1944, appropriated $10,000,000 for allocation to cities, counties, and cities and counties to develop a postwar public works program comprising the preparation of surveys and acquisition of rights-of-way for proposed public works and acquisition of rights-of-way and sites for major streets, roads, bridges, sewage and other public facilities. Of the money appropriated, $6,875,000 was obligated for defraying up to 50 percent of the cost of preparing plans for proposed public works and $3,000,000 was obligated for payment of up to 50 percent of the cost of acquisition by local agencies of rights-of-way and sites for construction of public works projects. Small sums were also made available for administrative costs.

TABLE E

ADEQUACY* OF EXISTING TREATMENT FACILITIES

MUNICIPAL 1/

Number of Municipal 1/ Treatment Facilities	Satisfactory	Unsatisfactory	Undetermined
44	27	7	10

1/ Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

TABLE F

ADEQUACY* OF EXISTING TREATMENT FACILITIES

INDUSTRIAL 1/

Number of Industrial 1/ Treatment Facilities	Satisfactory	Unsatisfactory	Undetermined
6	1	4	1

1/ Industries having separate outlets discharging wastes directly to watercourse or land disposal area.

TABLE G

PROGRESS IN CONSTRUCTION OF POLLUTION ABATEMENT FACILITIES

Year	Municipal		Industrial	
	Sewage Treatment Plants Completed	Design Population	Waste Treatment Plants Completed	Amount of Waste Treated (In terms of Equiv.No.People)
1946	---	---	---	---
1947	---	---	---	---
1948	1	8,000	---	---
1949	---	---	---	---
1950	5	517,250	---	---
1951	2	3,200	1	---

* "Adequacy", as used here, indicates discharges from those facilities classified as satisfactory have caused no complaints and appear, on the basis of preliminary investigations, to be satisfactory for present conditions. In most cases, however, no special surveys have been made or hearings held as required by California law to determine legally whether "pollution" or "nuisance" is existing or threatened.

Under the provisions of Chapter 47 as amended by Chapter 293, Statutes of 1951, applications may be filed until June 30, 1953, and encumbrances paid until June 30, 1954.

Chapter 20, known as the "Construction and Employment Act" became effective May 21, 1946. The Act appropriated $90,400,000 of which $400,000 was obligated for administrative expense. Of the money appropriated, $45,000,000 was allotted to the cities in the State and apportioned to the cities in the proportion that the population of each city bears to the total population of all the cities in the State as reported by the 1940 census. The construction of sewerage facilities was given first priority by the Act and it was stipulated that application by cities for construction of other projects would not be considered unless the State Department of Public Health first certified that existing sewerage facilities were adequate to meet the reasonable needs of the city or that provision had already been made to finance construction of needed sewerage facilities. The allotments to the cities were in the form of grants made on a matching basis not to exceed 50 percent of the total cost of the project.

The Act also made $45,000,000 available to the counties of the State, one-third to be apportioned for road and bridge construction and the remaining two-thirds to be made available for construction of other projects in which there is a State interest such as hospitals, schools, sewerage facilities, roads, flood control, fire prevention and harbor improvements.

As originally written, any funds from the appropriation remaining unapportioned as of December 31, 1949 were to revert to the general fund, but this date has been advanced twice. Chapter 292, Statutes of 1951, the latest amendment, provides that applications may be filed until December 31, 1953, and encumbrances paid until December 31, 1954.

Recent State Legislation and Activities - Because of important changes in legislation on water pollution control enacted by the California Legislature at its 1949 regular session, current procedures for prevention of water pollution differ drastically from those previously in effect. Prior to December 15, 1949, the effective date of the new legislation, the State Department of Public Health had primary responsibility, through provisions of the Health and Safety Code, for control of water pollution by means of a permit system. The Division of Fish and Game, the Division of Water Resources and other State and local governmental units also had an interest in and responsibilities for certain phases of water pollution problems.

The 1949 legislation was enacted following a two-year study conducted by a legislative Interim Fact-Finding Committee on Water Pollution. The recommendations of the Committee were used to draft a series of eleven bills which were revised and finally enacted in the 1949 legislative session.

The permit law was repealed by the 1949 legislation. The term "contamination" is defined to mean an impairment of the quality of the waters of the State by sewage or industrial waste creating an actual hazard to the public health through poisoning or through the spread of disease, and includes any equivalent effect resulting from the disposal of sewage or industrial waste, whether or not waters of the State are affected. Both State and local health officers are empowered to issue peremptory orders for abatement of "contamination", and any person failing to correct such a condition may be guilty of a misdemeanor.

The terms "pollution" and "nuisance" are defined to mean the adverse and unreasonable effects of disposal of sewage or industrial waste which are not actual health hazards. "Pollution" and "nuisance" are subject to control by Regional Water Pollution Control Boards created for the nine major drainage regions of the State. The Regional Boards are composed of five members representing the major interests involved. They coordinate the activities of the numerous governmental agencies involved and make and enforce rulings as to conditions to be maintained in instances of pollution and nuisance, existing or threatened, within their region. Upon failure of anyone to comply with an order of a Regional Board, an action for injunctive relief must be brought by the District Attorney, or if he should fail to act, by the Attorney General. The Regional Boards may not specify the manner or means of maintaining the required conditions.

A State Water Pollution Control Board has also been created, consisting of the State Engineer, the Directors of Departments of Public Health, Agriculture and Natural Resources, and nine appointees representative of the nine regions and the various interests. The State Board does state-wide planning for pollution control, acts in an advisory capacity to the Regional Boards, directs research programs in the technical phases of pollution control, administers the State Water Pollution Control Fund, and may act as an appeal board in any specific instance of pollution where it is found that a Regional Board has not taken proper action.

Each of the Regional Boards and the State Board are provided an executive officer and staff. Administration funds are appropriated to the State Board for allocation to the Regional Boards. The State and Regional Boards may require any State or local agency to inspect and report on any technical factors involved in water pollution and nuisance.

A fund to provide financial assistance to communities for construction of treatment works is administered by the State Board. Loans can be made only in hardship cases where the necessary works cannot be financed through private sources.

The new legislation makes funds available to the Division of Water Resources to conduct a continuing survey of water quality in the State with regard to pollution from all sources, including pollution of underground waters by improperly constructed wells. The Division is also studying the feasibility of reclaiming waste water for agriculture or industrial purposes. The University of California is also conducting research in technical problems of sewage, garbage, and industrial waste disposal under a $50,000 allocation.

The Regional Water Pollution Control Board has initiated comprehensive studies to determine the effects of existing waste disposals, the effectiveness of existing control measures and the conditions which it must require to safeguard the continued beneficial uses of water, both surface and underground. Under the state law such studies are conducted by the technical staffs of other State agencies with funds allocated by the Regional Board.

A breakdown of investigations to be conducted during the 1951-52 fiscal year appears on page 55. During the fiscal year 1950-51 $11,500 was allocated by the Regional Board for such studies.

Simultaneously, much basic research in pollution problems is being conducted on a statewide basis under contract by the State Water Pollution Control Board. Among prominent studies included in the State program are (1) the travel of pollution underground in various soil formations, (2) the effect on underground waters of wastes leaching from dumps, and (3) the compilation and summation of all existing data on water quality criteria. A digest of sewerage-enabling legislation has also been published for the information and guidance of municipalities and districts proposing sewage works construction.

Three types of problems complicate the waste disposal problems of the area. (1) Due to its strategic military position and the presence of many military installations and aircraft production industries, the area is particularly susceptible to huge population increases during periods of intensive military activity or emergencies. (2) Due to its excellent climatic conditions the region is attracting increasing numbers of persons from all parts of the United States who choose to make the area their permanent home. (3) Due to its desirable beach areas and beautiful inland terrain, there is a tendency for newcomers to settle in the unincorporated fringe areas adjacent to, or within easy access of existing population centers. As indicated on Map 4, areas presently requiring, or which soon will require sewerage facilities comprise nearly as much land area as do those presently sewered.

Many of the soils in the areas in question are of types which make difficult recourse to normal individual waste disposal methods. For the same reason, and also due to the concentrated growth of these areas, community disposal sites are difficult to find. The above conditions combined with the topographic features have made it necessary in many cases for communities to band together in joint use of trunk sewers, treatment plants, and disposal facilities in order to economically solve their waste disposal problems.

For these reasons, the Regional Water Pollution Control Board has placed major emphasis on long-range planning activities. To aid and work with the local agencies in developing long-range plans, the Board is completing a survey of existing water uses and waste discharges as a basis for determining beneficial water uses which can be reasonably maintained. Recognizing that many of the community sewerage problems are regional in scope, the Board has advocated joint planning between communities, both incorporated and unincorporated, and has encouraged and assisted them in obtaining sufficient information to permit orderly development and consummation of long-range programs.

At the Board's suggestion, a Metropolitan Sewage Planning Committee was formed in January, 1951 for the purpose of studying the sewerage problems of the Metropolitan area. The following progress report, prepared by the Committee, outlines the pressing and interrelated problems of sewage disposal for the cities and unincorporated areas of the south bay area and stresses the urgency of adopting a joint solution to eliminate inequities in financing needed sewerage facilities.

PROGRESS REPORT OF THE

METROPOLITAN SEWAGE PLANNING COMMITTEE

"On December 19, 1950 the San Diego Regional Water Pollution Control Board, after consultation with the several city managers and other city and county officials, sent a letter to the governing bodies of each of the five cities comprising metropolitan San Diego and to the Board of Supervisors of San Diego County, pointing to the need for joint planning on matters pertaining to sewage collection, treatment and disposal, and requesting the appointment of representatives to serve on a Metropolitan Sewage Planning Committee. By January 15, 1951 notification had been received from each agency concerned that, in accordance with the original request, each had appointed members, representing water, planning and engineering interests, to the Committee.

"On February 8, 1951 the Committee held its first meeting and elected Mr. Jean Vincenz as Chairman, Capt. A. K. Fogg as Vice Chairman, and H. E. Miller as Secretary The Committee also authorized the Chairman to appoint an Executive Committee comprised of the three officers and two additional members. The Chairman subsequently appointed Mr. Keir Brooks and Mr. Fred Wagner to the Executive Committee. Since that time, the Committee has held regular monthly meetings. Meeting attendance has been good and interest in the problems at hand has been keen.

"Five technical sub-committees have been named, an inventory of existing facilities and problems has been made, the advice and counsel of recognized experts in metropolitan sewage problems has been sought and has been received, and similar problems and solutions thereof in other areas of the state and country have been studied.

"Meetings have been conducted on informal basis and with a full understanding by all members that the Committee's function was primarily one of study and that ideas expressed were those of the individual and in no way indicative of the official attitude of the agency represented.

"The Committee reports the following findings:

"1. Every city of the area has a concrete and, in almost every case, a pressing sewage problem.

"2. A sanitary survey of San Diego Bay just completed indicates that certain areas of the Bay have about reached capacities for receiving wastes if nuisances and other adverse economic effects are to be avoided.

"3. By reason of topography, the problem is regional in scope and the solutions to the problems of the several agencies are inter-related.

"4. The problem of the surrounding unincorporated areas is equally pressing because of the same topographical features and because soil conditions eliminate the possibility of continuing normal private disposal methods.

"5. Under these conditions, costs of private disposal become prohibitive to the point where development of the area must either be curtailed, nuisance conditions and public health menaces must be invited, or numerous small community type treatment works must be permitted to be developed just outside the limits of cities.

"6. There is strong indication that in many instances the present individual approach to the solution of problems has not been productive of the best results. In this connection it is significant to note that while each of the cities have in the past retained as many as three independent engineering firms, no two recommendations have been in accord nor have any taken proper cognizance of adjacent and related problems.

"7. The problem is not confined to what is normally considered the metropolitan San Diego area. It prevails throughout the South Bay area, El Cajon Valley and the ocean beach area all the way from San Diego to Oceanside, as well as in the fringes of Escondido and the unincorporated towns throughout San Diego County.

"8. Present individual plans call for the immediate expenditure of nearly $2,000,000 for treatment works and appurtenances and another $1,500,000 will be spent almost immediately on either plants or private disposal systems. Within a period of from three to eight years another $2,500,000 will probably be spent in San Diego for treatment works. Roughly $3,000,000 will be spent in the next 15 years to keep existing and proposed treatment plants apace with normal population growth. Careful planning estimates indicate that by 1965, facilities will need to be provided for nearly 30,000 dwelling units in areas presently not sewered. At existing costs of private units, this would represent a total expenditure of nearly $12,000,000. In other words, approximately $7,500,000 will probably be spent in the metropolitan cities by 1965, and $12,000,000 will be spent in areas surrounding cities during the same period. This represents a total investment of $19,000,000 to $20,000,000 in the next 15 years. If the present piece-meal type of development is permitted to continue, it must be anticipated that one-half again that amount will be spent in the years immediately following to correct the situation which is bound to develop.

"9. No real consideration is presently being given to the relationship between problems of sewage disposal and water development and distribution and the possible need for reclamation of water from sewage and industrial wastes.

'10. The present approach is working an inequity on cities who have financed their existing systems and are now being constantly prodded to make their limited capacities available to adjacent areas.

"11. A problem of this magnitude should not be placed in the hands of one engineering firm but rather a Board of at least three outstanding experts in metropolitan type sewage problems and preferably engineers who will not ultimately do the detailed design work.

"12. Every similar metropolitan area in the United States eventually comes to some form of joint solution to its problems. It is interesting to note that whereever this has not taken place in advance of the actual need, development has been curtailed and costs of corrective measures have been almost prohibitive.

"The Committee concludes as follows:

"1. There is need for a comprehensive detailed study of the sewage problem throughout San Diego County and for the subsequent development of a long-range plan based on the technical and economical considerations involved.

"2. The Metropolitan Sewage Planning Committee is not equipped to make such a study or to develop such a plan both because its membership lacks the necessary technical ability and experience, and because all of its members are employed on a full-time basis on other duties.

"3. An estimated cost of approximately $60,000 necessary for such study and planning would represent an investment of approximately ¼ of 1% of expenditures contemplated or necessary in the next 15 years.

"4. Since the problem is County-wide and, since the cities contribute their proportionate share to the County Treasury, the logical agency to take official action and to finance the suggested study and planning is the County Board of Supervisors.

"5. In view of the urgency of the problem as evidenced by the fact that three cities of the metropolitan area alone are contemplating the immediate expenditure of nearly $1,500,000, such a study should be commenced without delay.

"The Committee recommends to its sponsoring agencies that the County Board of Supervisors be requested to include in its 1951-52 fiscal year budget, and to appropriate therefrom, the sum of $60,000 for the purpose of retaining a Board of three engineers to:

"1. Conduct a comprehensive investigation of the sewage and industrial waste collection and disposal problem on a county-wide basis.

"2. Develop comprehensive long-range plans.

"3. Recommend practical methods by which plans can be placed into effect.

"4. Recommend, if necessary, enabling legislation to fit the needs of this area with respect to the recommendations.

"5. Submit a report of its findings, conclusions and recommendations."

"In connection with its recommendations, the Committee desires to underscore the fact that even if all the recommendations contained in the proposed report were not eventually placed in effect, the plans developed would form a sound basis for individual planning, and would be bound to encourage an inter-community approach to the technical and economic aspects of future developments."*

Subsequent to issuance of the foregoing report, the San Diego County Board of Supervisors appropriated $60,000.00 for a county-wide sewerage survey and retained three outstanding sanitary engineers to serve as a Board of consultants. Under terms of the contract, the survey is to be completed by September 1, 1952.

Also planned by the Regional Water Pollution Control Board, to commence in the near future, is a program of comprehensive training and supervision of treatment plant operators in order to assure a maximum return for the investment on waste treatment facilities in the Basin.

Nine soil conservation districts are attempting to solve the San Diego erosion problems, which affect both water and land resources.

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*Since the time of adoption of the Progress Report, the Committee has been made county-wide in scope, and membership from areas outside the metropolitan area has been added.

POLLUTION PREVENTION MEASURES REQUIRED

Table C, page 41, indicates there are two communities in the Basin, with a combined population of 14,600, that have no waste treatment facilities and are discharging raw sewage to San Diego Bay. Table E, page 43, indicates there are also seven existing municipal treatment plants, serving a combined population of 10,260, that are inadequate. These nine communities should proceed with construction of the necessary treatment facilities upon receipt of requirements from the Regional Water Pollution Control Board. Table H, page 53, indicates eight of the nine municipalities are actively planning the required new plants or improvements to existing plants and the one remaining community is inactive. (Map 5)

Table E, page 43, also indicates there are ten municipal plants, serving a combined population of 384,980, the adequacy of which has not been determined. Some of these waste discharges are already being studied by the Regional Water Pollution Control Board and the State and local Departments of Public Health to determine if a condition of "pollution" or "contamination" exists or threatens to exist. Others of these discharges will be investigated as time permits and conditions warrant. As the Regional Board completes these investigations and **proscribes** requirements for eliminating the unsatisfactory conditions, the community should proceed at once with construction of the necessary facilities to meet the waste discharge requirements prescribed by the Board.

Table D, page 41, indicates there are six known industries in the Basin with no treatment facilities. Table F, page 43, indicates that of the six known industries with treatment facilities, four of the facilities are unsatisfactory, one is satisfactory and one undetermined. Table I, page 53, indicates that of the 11 known industries which have no treatment or inadequate treatment, six now have connections to existing sewerage systems under construction, two are inactive, and the needs of three are undetermined. The industries that are now inactive or the needs for which are undetermined should proceed with construction of the necessary facilities when requirements have been set by the Regional Board.

The San Diego Harbor Department has completed a survey of the unsewered industrial areas of the harbor and established a priority schedule for construction of needed sewerage facilities. The industrial area from Beardsly Street to 28th Street was given highest priority and construction of intercepting sewers and a pumping station to serve the major portion of this area is to be completed in 1951.

The San Diego Basin is part of rapidly developing Southern California, one of the fastest growing areas in the nation. Provision of adequate sewage treatment facilities in an area that has almost doubled in population during the past ten years places a heavy burden on public officials. Some of the major cities, such as Oceanside, La Mesa, Chula Vista, and El Cajon have doubled and in some cases even tripled in population during the ten year period from 1940 to 1950.

TABLE H

CURRENT STATUS OF MUNICIPAL 1/ ACTION ON POLLUTION ABATEMENT NEEDS

Status of Action	Number of Municipalities 1/
Inactive	1
Active Planning*	8
Under Construction	0
Undetermined	0

1/ Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

TABLE I

CURRENT STATUS OF INDUSTRIAL 1/ ACTION ON POLLUTION ABATEMENT NEEDS

Status of Action	Number of Industries 1/
Inactive	2
Active Planning*	0
Under Construction	6 2/
Undetermined	3

1/ Industries having separate outlets discharging wastes directly to watercourse or land disposal area.

2/ Connection to San Diego City Sewerage System.

* All communities and industries in San Diego County are receiving the benefits of active planning through the San Diego County Sewerage Survey.

Although provision of adequate facilities in rapidly growing cities is a diffucult problem, the provision of such facilities for the unincorporated fringe areas is much more difficult. The fringe areas where much of the residential construction is taking place are shown on Map 4. Local pollution control and public health officials are continually faced with the problem of authorizing construction of private sewage disposal systems for each individual home or requiring a community sewerage system with the necessary treatment. The relatively impervious soil in many areas makes the construction of individual systems too costly for any but the most expensive types of residential construction. The per capita cost of construction and operation of community facilities to serve small sub-divisions is prohibitive. Location of sewage treatment plants adjacent to residential areas invariably leads to nuisance complaints and damage claims.

According to the Metropolitan Sewage Planning Committee, approximately $20 million dollars will be spent by individuals and communities in the County for sewerage facilities in the next 15 years. Adoption of a comprehensive county-wide sewerage plan, at present in advance of actual needs in many areas, as recommended by the Planning Committee, should assure an economical and orderly development of adequate sewerage facilities and eliminate the haphazard construction of small, poorly located plants that may have to be abandoned with no salvage value even before the bonds issued for construction of the plants are retired.

The Regional Water Pollution Control Board and the Metropolitan Sewage Planning Committee should be commended for their efforts to develop a comprehensive sewerage plan for San Diego County. It is hoped that the long range plan developed by the Regional Water Pollution Control Board for solving the waste disposal problems of the Basin and the action program recommended to complement the plan can be adopted as the comprehensive program which Public Law 845 requires the Surgeon General of the Public Health Service to prepare or adopt.

As soon as a sound, logical plan has been developed, it should be given the necessary publicity and support to assure financing and completion of the program in an orderly manner. Such a plan should give special consideration to solving such pressing problems as the provision of new or improved treatment facilities for communities and industries where such needs are known as well as providing adequate facilities for future residential construction as needed.

There is also a need for more comprehensive training and supervision of treatment plant operators in order to assure a maximum return for the investment on waste treatment facilities in the Basin. Such training should be slanted toward giving operators a better understanding of the basic physical, biological, and chemical factors involved in the various treatment processes as well as practical training in operation and maintenance of equipment.

Of the 102 monthly stream sampling stations established April, 1951, by the State Water Pollution Control Board six are in Region 9, the San Diego Basin, as follows:

MONTHLY STREAM SAMPLING PROGRAM

REGION 9

Station No.	Stream	Near
51c	Santa Margarita River	Fallbrook
62	San Luis Rey River	Pala
63	Escondido Creek	Harmony Grove
64	San Dieguito River	Below San Pasqual Valley
65	San Diego River	Old Mission Dam
66	Tia Juana River	Nestor

The Department of Fish and Game, the Bureau of Sanitary Engineering of the State Department of Public Health, and the Division of Water Resources of the State Department of Public Works, are all participating in the sampling program. Chemical analyses are made at the U. S. Geological Survey laboratory at Davis under cooperative agreement with the Division of Water Resources and at the Division's laboratory in San Bernardino. Bacterial examinations are made at the Bureau of Sanitary Engineering laboratories in Los Angeles and Berkeley. Dissolved oxygen, pH and temperature are determined at the time of sampling. Not enough data are available so far to permit drawing conclusions although two samples collected on Escondido Creek below the Escondido sewage treatment plant showed low dissolved oxygen content. No stream flow was recorded in May at three of the six stations.

The following table describes the program of water pollution investigations to be conducted at the request of the Regional Board by State agencies in Region No. 9 during fiscal year 1951-52.

PROGRAM OF WATER POLLUTION INVESTIGATIONS
by
STATE AGENCIES FOR FISCAL YEAR 1951-52

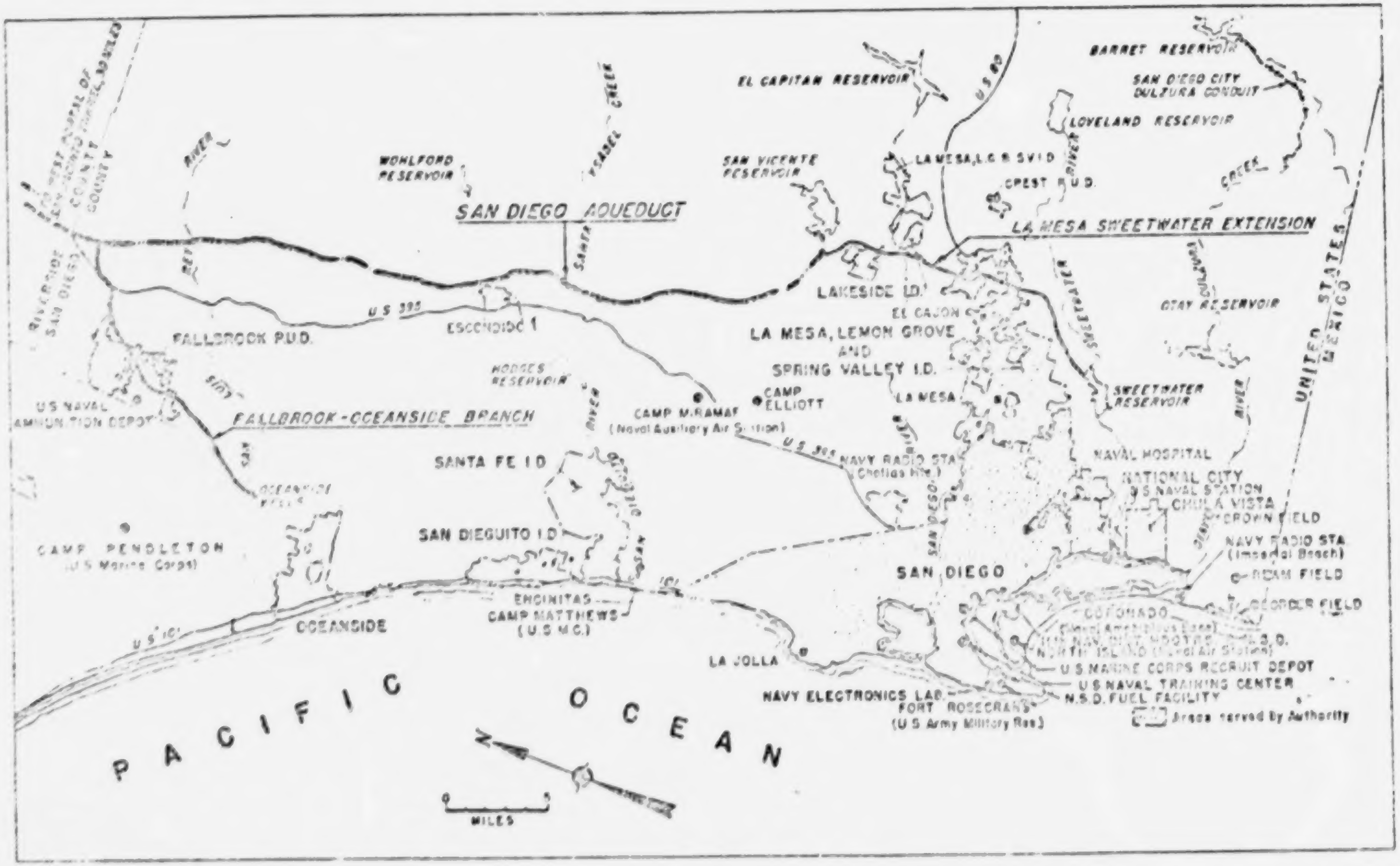
Region 9 (San Diego Basin)

Code No.	Investigation Description	Agency Primarily Respbl.	Fld.Wrk. Completion Date	1951-52 Estimated Cost BSE*	DWR*	F&G*
52-9-1	San Diego Bay	BSE	9-15-51	4000	500	770
52-9-2	Disposal of wastes, San Diego Metropolitan area, as affected by proposed reclamation projects.	DWR	6-30-52	200	2600**	---
52-9-3	Beach investigations, Tia Juana, Oceanside and Carlsbad.	BSE	8-15-51	700	---	450
52-9-4	Investigation of Central Water Softening Recharge plants.	DWR	5-31-52	---	1400	---
52-9-5	Critical waste discharges.	BSE	6-1-52	500	---	---
52-9-6	Special reports for proposed waste discharges.	---	---	600	500	230
	Totals			$6000	$5000	$1500

* BSE - Bureau of Sanitary Engineering
DWR - Division of Water Resources
F&G - Department of Fish and Game

** Will be coordinated with general studies of reclamation of wastes being conducted under Chapter 1552, Statutes of 1949; an Act which added Sections 229, 230, 231 to, and Chapter 7 to Division 4 of, the Water Code of the State of California.

These surveys are in addition to routine investigations being conducted by State departments under authority granted by various statutes to investigate conditions of the quality of all waters within the State.


SAN DIEGO AQUEDUCT
LA MESA SWEETWATER EXTENSION
FALLBROOK-OCEANSIDE BRANCH
BARRET RESERVOIR
SAN DIEGO CITY DULZURA CONDUIT
LOVELAND RESERVOIR
EL CAPITAN RESERVOIR
SAN VICENTE RESERVOIR
WOHLFORD RESERVOIR
HODGES RESERVOIR
OTAY RESERVOIR
SWEETWATER RESERVOIR
LA MESA, L.G. & S.V.I.D.
CREST P.U.D.
LAKESIDE I.D.
EL CAJON
LA MESA, LEMON GROVE AND SPRING VALLEY I.D.
LA MESA
CAMP ELLIOTT
CAMP MIRAMAR (Naval Auxiliary Air Station)
NAVY RADIO STA (Chollas Hts.)
NAVAL HOSPITAL
NATIONAL CITY
U.S. NAVAL STATION
CHULA VISTA
BROWN FIELD
NAVY RADIO STA (Imperial Beach)
REAM FIELD
GEORGE FIELD
CORONADO
U.S. MARINE CORPS RECRUIT DEPOT
U.S. NAVAL TRAINING CENTER
N.S.D. FUEL FACILITY
NAVY ELECTRONICS LAB.
FORT ROSECRANS (U.S. Army Military Res.)
SAN DIEGO
LA JOLLA
ENCINITAS
CAMP MATTHEWS (U.S.M.C.)
SAN DIEGUITO I.D.
SANTA FE I.D.
ESCONDIDO
FALLBROOK P.U.D.
U.S. NAVAL AMMUNITION DEPOT
CAMP PENDLETON (U.S. Marine Corps)
OCEANSIDE
PACIFIC OCEAN
RIVERSIDE COUNTY
SAN DIEGO COUNTY
SANTA YSABEL CREEK
SAN LUIS REY RIVER
SAN DIEGO RIVER
SWEETWATER RIVER
OTAY RIVER
U.S. 395
U.S. 101
U.S. 80
UNITED STATES
MEXICO
MILES
Areas served by Authority

AREAS IN SAN DIEGO COUNTY SERVED BY THE SAN DIEGO AQUEDUCT AND ITS BRANCHES

APPENDIX TO SAN DIEGO
BASIN REPORT

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TABLE 1

BASIC DATA ON SOURCES OF MUNICIPAL* WASTE DISCHARGE

SAN DIEGO BASIN

Name and Location	Shore Line Miles North From Mexico-U.S. Border	Population Served by Sewers	Est P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P.E. (B.O.D.) Discharged**	Current Status Municipal* Action
PACIFIC OCEAN							
Mexico-United States Border	0						
Tijuana-San Ysidro Cutfall	0.7	---	Listed under Tia Juana River	---	---	27,700 to ocean	---
Tia Juana River Enters	1.5						
1.North Island Naval Air Sta.	28	10,000	To San Diego System				
2.Coronado	29	13,000	13,000	None	None	13,000 1/ to ocean	Active Planning
3.Naval Amphib. Base(Coronado)	29	1,600	1,600	None	None	1,600 1/ to ocean	Active Planning
Otay River enters	39.3						
4.Chula Vista South Plant	41	16,000	16,700	Intermediate plus chlorination	Satisfactory	5,000 1/ to ocean	---

1/ Disposal to San Diego Bay.

TABLE 1 (Cont.)

Name and Location	Shore Line Miles North From Mexico-U. S. Border	Population Served by Sewers	Est. P. E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P. E. (B.O.D.) Discharged**	Current Status Municipal* Action
4.North Plant	42	200	200	Primary plus chlorination	Satisfactory	140 4/ to ocean	---
Sweetwater River Enters	42.8						
5.National City	47	19,000	To San Diego System				
6.La Mesa	47	10,000	To San Diego System				
7.Lemon Grove	47	3,500	To San Diego System				
8.Rolando	47	4,600	To San Diego System				
9.San Diego	47	345,000	469,600 2/	Primary 3/	Undetermined	280,000 4/ to ocean	---
San Diego River Enters	70.2						
Rose Canyon Enters	76.2						
Soledad Creek Enters	95.4						
San Dieguito River Enters	98.5						
Escondido Creek Enters	101.0						

2/ Includes 49,600 population from six adjacent communities and 75,000 pop. equiv. from industries connected to system.
3/ Primary treatment with preaeration.
4/ Disposal to San Diego Bay.

TABLE 1 (Cont.)

Name and Location	Shore Line Miles North From Mexico-U.S. Border	Population Served by Sewers	Est. P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P. E. (B.O.D.) Discharged**	Current Status Municipal* Action
10. Carlsbad	111	830	830	Primary	Unsatisfactory	580 to ocean	Active Planning
Buena Vista Creek Enters	112.1						
11. Oceanside	114	12,800	12,800	Primary 5/ plus chlorination	Satisfactory	7,700 to ocean	---
San Luis Rey River Enters	115.0						
12. Camp Pendleton Plant No. 6	115	6,000****	6,000	Primary plus chlorination	Satisfactory	4,000 to ocean	---
12. Camp Pendleton Plant No. 4	116	6,000****	6,000	Primary plus chlorination	Satisfactory.	4,000 to ocean	---
12. Camp Pendleton Plant No. 5	117	6,000****	6,000	Primary plus chlorination	Satisfactory	4,000 to ocean	---
Santa Margarita River Enters	117.4						
13. San Clemente	137	3,000	3,000	Secondary plus chlorination	Satisfactory	300 to land or ocean	---
14. Capistrano Beach Land Co.	140	270	270	Primary	Undetermined	180 to ocean	Studies Underway*** **
San Juan Creek Enters	142						

5/ Preaeration in addition to primary treatment.

TABLE 1 (Cont.)

Name and Location	Shore Line Miles North From Mexico-U. S. Border	Population Served by Sewers	Est. P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P. E. (B.O.D.) Discharged**	Current Status Municipal* Action.
15.Doheny Beach State Park	142	760	760	Primary plus chlorination	Satisfactory	490 to ocean	---
16.Dana Point Sewer Mainten.District	143	900	900	Primary plus chlorination	Undetermined	450 Dry wash-1000' to ocean	Studies Underway*****
17.Laguna Beach	150	8,800	8,800	Secondary plus chlorination	Undetermined	1,300 to ocean	Studies Underway*****
4	River Miles Above Mouth Outlet Stream						
TIA JUANA RIVER							
Cottonwood Creek Enters	11						
18.Brown Field	7	170	170	Secondary	Satisfactory	30	---
19.Tijuana	6	26,500	26,500	Minor	Undetermined 6/		---
			(To Tijuana - San Ysidro Outfall)				
20.San Ysidro	5	1,200	1,200	Minor	Undetermined		---
			(To Tijuana - San Ysidro Outfall)				
21.Ream Field	2	300	300	Primary and chlorination	Satisfactory	150 to tidal waters	---
22.Imperial Beach	2	1,500	1,500	Secondary	Satisfactory	130 to tidal waters	---
23.U.S.N.Communications School	2	150	150	Primary and chlorination	Undetermined	100 to tidal waters	---

---

6/ Sewage from Tijuana passes through a septic tank, which is believed ineffective. San Ysidro has provided comminution and chlorination, and has funds for joint action (with Tijuana) to provide more treatment facilities.

TABLE 1 (Cont.)

Name and Location	River Miles Above Mouth Outlet Stream	Population Served by Sewers	Est. P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P. E. (B.O.D.) Discharged**	Current Status Municipal* Action
COTTONWOOD CREEK							
Rio de Tecate Enters	14						
RIO DE TECATE							
Campo Creek Enters	13						
CAMPO CREEK							
24.Campo	6	100	100	Secondary	Satisfactory	Negligible	---
SAN DIEGO RIVER							
Coleman Creek Enters	50						
25.Edgemoor Farms (Santee)	20	450	450	Secondary	Undetermined	125 to land	---
Forester Creek Enters	18						
Alvarado Canyon Enters	9						
Murphy Canyon Enters	8						
COLEMAN CREEK							
26.Julian Sanitation District	6	80	80	Primary	Unsatisfactory	65 to land	Active Planning

TABLE 1 (Cont.)

Name and Location	River Miles Above Mouth Outlet Stream	Population Served by Sewers	Est. P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P. E. (B.O.D.) Discharged**	Current Status Municipal* Action
FORRESTER CREEK							
27.El Cajon	5	5,000	6,200	Secondary plus chlorination	Unsatisfactory	3,100	Bond Election 6-15-51
28.Gillespie Field	3	200	200	Secondary	Satisfactory	140 to land	
ALVARADO CANYON							
29.Fletcher Hills Sanitation Dist.	7	900	900	Secondary	Undetermined	600 to land	Studies Underway****
30.San Diego State College	2	2,500	Goes To San Diego System				
MURPHY CANYON							
31.Camp Elliot	5	450	450	Secondary plus chlorination	Satisfactory	20	—
ROSE CANYON							
32.N.A.A.S. Camp Miramar	14	1,700	1,700	Primary plus chlorination	Satisfactory	1,000	—
32.N.A.A.S.Camp Miramar (Kearney)	12	300	300	Primary plus chlorination	Satisfactory	180	—
33.Camp Mathews	6	400	400	Secondary plus chlorination	Satisfactory	60	—

TABLE 1 (Cont.)

Name and Location	River Miles Above Mouth Outlet Stream	Population Served by Sewers	Est. P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P. E. (B.O.D.) Discharged**	Current Status Municipal* Action
SOLEDAD CREEK							
34.Camp Callan	2	300	300	Secondary plus chlorination	Satisfactory	30	---
SAN DIEGUITO RIVER							
Santa Maria Creek Enters	22.5						
35.Rancho Santa Fe	6	215	215	Secondary	Satisfactory	30 to land	---
36.22nd Agriculture Dist. (Del Mar)	1	2,500	2,500	Primary	Unsatisfactory	1,750 to tidal waters	Active Planning
37.Del Mar Sanitary Co.	1	1,000	1,000	Primary	Unsatisfactory	700 to tidal waters	Active Planning
SANTA MARIA CREEK							
38.Ramona Sanitation District	11	600	600	Secondary plus chlorination	Satisfactory	60 to land	---
ESCONDIDO CREEK							
39.Escondido	20	4,500	7,140	Secondary plus chlorination	Satisfactory	1,100	---
40.Solano Beach	1	850	850	Secondary plus chlorination	Satisfactory	130 to tidal waters	---
BUENA VISTA CREEK							
41.Vista Sanitation Dist.	10	810	810	Secondary	Undetermined	120	---

TABLE 1 (Cont.)

Name and Location	River Miles Above Mouth Outlet Stream	Population Served by Sewers	Est. P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P. E. (B.O.D.) Discharged**	Current Status Municipal* Action
SAN LUIS REY RIVER							
Pilgrim Creek Enters	5						
PILGRIM CREEK							
12. Camp Pendleton Plant No. 1	4	15,000****	15,000	Secondary plus chlorination	Satisfactory	1,500 pumped to Santa Margarita River Watershed	---
12. Camp Pendleton Plant No. 2	2	15,000****	15,000	Secondary plus chlorination	Satisfactory	2,200 pumped to Santa Margarita River Watershed	---
SANTA MARGARITA RIVER							
Murrieta Creek Enters	28.4						
Fallbrook Creek Enters	18						
12. Camp Pendleton Plant No. 3	7	9,000****	9,000	Secondary plus chlorination	Satisfactory	1,000	---
MURRIETA CREEK							
Warm Springs Creek Enters	4						
WARM SPRINGS CREEK							
42. Murrieta Hot Springs	3	500	500	Primary	Unsatisfactory	300	Inactive

TABLE 1 (Cont.)

Name and Location	River Miles Above Mouth Outlet Stream	Population Served by Sewers	Est. P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy*** Of Existing Treatment Facilities	Est. P.E. (B.O.D.) Discharged**	Current Status Municipal* Action
FALLBROOK CREEK							
43.Fallbrook S.D. and U. S. Navy	1	850	850	Primary plus chlorination	Satisfactory	550	---
SAN JUAN CREEK							
44.San Juan Capistrano Sanitary District	4	600	600	Secondary plus chlorination	Satisfactory	180 to land	---
45.Capistrano Beach Sanitary District	2	350	350	Primary plus chlorination	Unsatisfactory	230 to ocean	Active Planning
Total 45		562,235	641,775 -79,540 562,235	2 minor 20 primary 1 intermed. 21 secondary 2 none	27 Satisfactory 7 Unsatisfactory 10 Undetermined	11,1[illegible]0 to Watercourse 1,500 to Land 353,330 to Ocean 366,020	

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

** Includes industrial wastes discharged into municipal sewerage systems. Estimated Population Equivalent based on Biochemical Oxygen Demand.

*** See Table E, page 4 for definition of adequacy as used here.

**** Treatment plant design capacities indicated rather than actual populations.

***** Present conditions are not designated as unsatisfactory - Studies being made in advance of actual needs.

TABLE 2

BASIC DATA ON SOURCES OF INDUSTRIAL* WASTE DISCHARGE

SAN DIEGO BASIN

Name and Location	Shore Line Miles North From Mexico-U. S. Border	Type Industry	Type Waste Produced	Treatment or Other Pollution Control Measures:		P.E. (B.O.D.) Discharged	Current Status Industrial* Action
				Degree	Adequacy**		
PACIFIC OCEAN							
Mexico-United States Border	0						
Otay River Enters	39.3						
National City	47						
1.Bush Citrus Prod., National City		Food	Organic	None	Needs Undetermined	Undetermined	Inactive
2.Wright Packing Co., National City		Food	Organic	None	Condition Unsatisfactory	Undetermined	Under**** Construction
San Diego	47						
3.West Coast Packing Co., San Diego		Food	Organic	Minor	Unsatisfactory	44,300***	Under Construction*****
4.Westgate-Sun Harbor, San Diego		Food	Organic	Minor	Unsatisfactory		
5.San Diego Packing Co. San Diego		Food	Organic	Minor	Unsatisfactory		
6.Van Camp Sea Food Co. Inc., San Diego		Food	Organic	Minor	Unsatisfactory		

TABLE 2 (Cont.)

Name and Location	Shore Line Miles North From Mexico-U. S. Border	Type Industry	Type Waste Produced	Treatment or Other Pollution Control Measures: Degree	Adequacy**	P.E. (B.O.D.) Discharged	Current Status Industrial* Action
7.High Seas Tuna Packing Co.Inc., San Diego		Food	Organic	Minor	Satisfactory	6,770***	None
8.American Processing Co., San Diego		Food	Organic	None	Condition Unsatisfactory	20,600***	Under Construction*****
9.Kelco Co., San Diego		Food	Organic & Inorganic	None	Condition Unsatisfactory	73,500***	Inactive
	River Mile Above Mouth Outlet Stream						
OTAY RIVER							
10.Otay Mesa Hog Ranches	8	Food	Organic	None	Needs Undetermined	Undetermined	Undetermined
11.Omar Rendering Co.	8	Food	Organic	Primary	Undetermined	Undetermined	Undetermined
12.Wm. O'Donnel Hog Ranch	6	Food	Organic	None	Needs Undetermined	Undetermined	Undetermined
Total 12						145,170***	

* Industries having separate outlets and discharging wastes directly to watercourse or land disposal area.

** See Tables E and F, page 44, for definition of "adequacy".

*** Based on B.O.D. values determined with sea water rather than standard dilution water.

**** Connection to San Diego City Sewerage System.

***** Connection to San Diego Sewerage System for fresh water wastes. Construction will not affect wastes from thaw tanks and fluming operations.

TABLE NO. 3

Area Distribution
San Diego Basin of California

Counties	Area of Co. (Sq. Mi.)	Area of Co. In Basin (Sq. Mi.)	Percent of Co. in Basin	Percent of Basin Represented By Co.
Orange	795	260	33	7
Riverside	7,223	650	9	16
San Diego	4,221	3,020	72	77
Totals		3,930		100

TABLE No. 4

Stream Data for Streams in San Diego County, California
Flowing into the Pacific Ocean
(Data from **Dept. of the Army U S Engineer Office**
Los Angeles, California)

Stream	Miles from Orange-San Diego County Boundary*	Total drainage area (sq.mi.)	Length (mi.)	Average slopes	
				In mountain area (ft./mi.)	In valley area (ft./mi.)
Arroyo San Mateo	0.2	133	24	280	33
Arroyo San Onofre	1.3	43	13	180	38
Horno Creek	7.5	3	4		
Las Pulgas Creek	10.5	28	7		
Aliso Creek	12.7	9	6		
Santa Margarita River	15.3	750	58**	141	20
San Luis Rey River	17.7	565	65	200	29
Loma Alta Creek	19.6	10	8		
Buena Vista Creek	20.6	21	10	105	25
Agua Hedionda Creek	22.3	30	11		
San Marcos Creek	26.5	53	16	200	25
Escondido Creek	31.7	88	26	175	16
San Dieguito River	34.2	347	55**	136	18
Soledad Creek	37.3	97	21**	56	7
Rose Creek	50.5	37	18**	50	20
Tecolote Creek	59.1	10	15		
San Diego River	62.5	435	52	175	15
Switzer Creek	63.4	4	4	110	57
Las Chollas Creek	65.8	26	9	51	20
La Paleta Creek	86.5	3	9		
Paradise Creek	89.0	5	12		
Sweetwater River	89.9	221	55	150	21
Telegraph Creek	93.0	8	7		
Otay River	93.4	144	30**	170	30
Tia Juana River	131.2	1,680	58**	140	30

---

* Measured along the ocean shore.
** From mouth to source of largest tributary.

TABLE No. 5

CLIMATOLOGICAL DATA - SAN DIEGO BASIN

(From U. S. Department of Commerce, Weather Bureau Annual Summary, 1946)

Town	Elev. (Ft.)	Rainfall (Ins.)	Snowfall (Ins.)	Days with 0.01 in. Precipitation	Ave. Temp.	Jan. Temp. Median		July Temp. Median		Length of Growing Season (Days)
						Max.	Min.	Max.	Min.	
San Diego	87	9.67		44	61.2	62.4	46.6	72.4	62.4	365
Point Loma	302	11.07			60.7	60.4	47.7	71.5	62.1	--
El Cajon	560	13.53		46	62.3	67.2	37.6	88.4	58.1	278
Escondido	750	15.92		41	60.8	64.5	36.2	88.5	55.4	255
Barrett Dam	1,600	19.36		48	60.9	63.2	34.4	93.8	57.7	-
Amago	2,715	28.33			55.8	50.2	39.8	77.0	60.6	---
Warner Springs	3,165	17.76	6.7	44	59.1	61.6	33.7	91.6	56.8	213
Cuyamaca	4,677	38.80	38.2	54	51.6	47.3	29.5	83.7	56.7	170
Nellie	5,000	47.97			53.3	47.0	31.0	83.8	57.4	162

TABLE No. 6

MEAN SEASONAL FULL NATURAL RUN-OFFS OF SAN DIEGO COUNTY STREAMS
1887 - 1933

(Data from Bulletin 48, San Diego County Investigation by State of California, Department of Public Works, Division of Water Resources -1935)

Stream or stream group	Above lowest potential reservoir		Below lowest potential reservoir		Totals	
	Area of basin, in square miles	Run-off, in acre-feet	Area of basin, in square miles	Run-off, in acre-feet	Area of basin in sq. miles	Run-off, in acre-feet
Principal Basins						
Santa Margarita River	710	24,050	33	2,190	743	26,240
San Luis Rey River	518	55,210	47	3,370	565	58,580
San Dieguito River	303	39,340	24	1,600	327	40,940
San Diego River	376	47,560	59	3,900	435	51,460
Sweetwater River	181	17,540	--	---	181	17,540
Otay River	99	7,650	--	---	99	7,650
Tia Juana River	*417	41,010	*44	3,530	*461	44,540
Totals, principal basins	2,604	232,360	207	14,590	2,811	246,950
Minor Basins						
San Mateo Creek to Aliso Creek	144	12,200	97	6,100	241	18,300
Loma Alta Creek to Escondido Creek	126	9,300	89	5,100	215	14,400
San Dieguito River to Tecolate Valley	70	5,500	108	6,300	178	11,800
Switzer Canyon to Otay River	12	800	153	9,800	165	10,600
Totals, minor basins	352	27,800	447	27,300	799	55,100
Grand Totals	2,956	260,160	654	41,890	3,610	302,050

* Includes area within the United States only.

Table 7

ESTIMATED MEAN SEASONAL NATURAL RUNOFF, 1894-95 TO 1946-47, INCLUDING RUNOFF OF STREAMS FOR WHICH THERE ARE NO RECORDS, SAN DIEGO REGION

(Source: Table 49, Bulletin No. 1, Water Resources of California, State Water Resources Board, 1951)

Basin, sub-basin, or stream group	Sub-basin or main tributary	Sub-totals	Total for basin or group
San Juan Creek Group			
Aliso Creek above gage at El Toro	500		
Trabuco Creek above gage nr.San Juan Capistrano	3,300		
San Juan Creek " " " " " "	8,700		
Remainder of San Juan Creek Group	5,900		18,400
Arroyo San Onofre Group			22,500
Santa Margarita River Basin			
Temecula Creek above gage at Nigger Canyon	11,800		
Murrieta Creek above gage at Temecula	8,670		
Remainder of Santa Margarita River above gage at Railroad Canyon	2,830		
Above gage at Railroad Canyon		23,300	
From gage at Railroad Canyon to gage nr.Fallbrook	4,700		
Above gage near Fallbrook		28,000	
From gage near Fallbrook to gage at Ysidora	9,100		
Santa Margarita River at mouth			37,100
San Luis Rey River Basin			
Above Henshaw Dam	29,900		
From Henshaw Dam to gage near Bonsall	28,900		
Above gage near Bonsall		58,800	
From gage nr.Bonsall to gage at Oceanside	3,400		
San Luis Rey River at mouth			62,200
San Marcos Creek Group			12,500
San Dieguito River Basin			
Above Hodges Dam	40,000		
From Hodges Dam to gage near Del Mar	5,000		
San Dieguito River at mouth			45,000
Los Penasquitos Creek Group			10,300

(Table 7 continued on page 17)

Table 7, continued

Basin, sub-basin, or stream group	Sub-basin or main tributary	Sub-totals	Total for basin or group
San Diego River Basin			
Boulder Creek above Cuyamaca Dam	4,730		
Remainder of San Diego River above El Capitan Dam	30,370		
Above El Capitan Dam		35,100	
San Vicente Creek above gage near Foster	7,520		
Remainder of San Diego River above Santee Dam	9,580		
Above Santee Dam		52,200	
Remainder of San Diego River above gage at Old Town (San Diego)	2,400		
San Diego River at mouth			54,600
San Diego Bay group			5,200
Sweetwater River Basin			
Sweetwater River above Sweetwater Dam	17,700		17,700
Otay River Basin			
Otay River above Lower Otay Dam	8,900		8,900
Tia Juana River Basin			
Cottonwood Creek above Morena Dam	12,400		
Remainder of Cottonwood Creek above Barrett Dam	14,700		
Above Barrett Dam		27,100	
Remainder of Tia Juana River Basin between Barrett Dam and international boundary	11,900		
Tia Juana River in California			39,000
TOTAL SAN DIEGO REGION			331,400

TABLE No. 8

Populations Trends for California and the Counties in the San Diego Basin of California

(Data from the U. S. Bureau of Census)

Area	Census Enumerations				Percent Increase from 1940 to 1950
	1900	1920	1940	1950	
Orange County	19,696	61,375	130,760	214,061	63.7
Riverside County	17,897	50,297	105,524	168,959	60.1
San Diego County	35,090	112,248	289,348	535,967	85.2
San Diego Basin	36,000	114,900	293,900	542,000	84.4
State of California	1,485,053	3,426,861	6,907,387	10,472,348	51.6

* The 1940 population of the San Diego **Basin** was determined by summation of the census reports for minor civil divisions. **Basin** populations for other years were computed by assuming the same percentage distribution, 5.8% of Orange County, 2.9% of Riverside County, and 97.9% of San Diego County.

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TABLE NO. 9

EMPLOYMENT AND PAYROLLS

San Diego County

(Data from 1950 Annual Business Survey by San Diego Chamber of Commerce)

Industry Group	Civilian Labor Force		Annual Payrolls	
	April 1, 1940(a)	April 1, 1950 (b)	1939 (d)	1949 (d)
Agriculture, Forestry Fishing, Mining	9,977	12,000	$ 15,000,000	$ 36,000,000
Construction	5,724	10,500(b)	10,000,000	33,000,000
Manufacturing	12,263	23,000(d)	11,000,000	78,000,000
Transportation, Communications, and Utilities	4,703	8,700(c)	7,000,000	16,000,000
Wholesale and Retail	21,288	30,650(b)	25,000,000	80,000,000
Finance, Insurance and Real Estate	3,899	5,050(c)	10,000,000	15,000,000
Services, Business and Personal	4,470	20,000(c)	6,000,000	40,000,000
Amusement, Recreation, etc.	1,409	2,165(b)	2,000,000	4,000,000
Professional and Related Services	8,926	10,000	18,000,000	24,000,000
Government	11,000	22,050(c)	15,000,000	62,000,000
Totals	83,659	144,065	$119,000,000	$388,000,000

Sources: (a) U. S. Census, (b) U. S. Department of Commerce, (c) California Department of Employment, (d) Estimates, San Diego Chamber of Commerce.

TABLE No. 10

Agricultural Crop Report
San Diego County - 1948
(Compiled by Dean F. Palmer, Agricultural Commissioner)
(Published by the Board of Supervisors of San Diego County
and the San Diego-California Club)

Crop	Acreage	Production	Value
Citrus Fruits			
Grapefruit	541	39,123 boxes (60 lb.)	$ 99,763
Lemons	7,046	666,807 boxes (78 lb.)	3,600,758
Limes	383	1,394 tons	111,520
Naval Oranges	847	122,532 boxes (71 lb.)	349,216
Valencia Oranges	6,936	715,361 boxes (74 lb.)	2,353,538
Other Citrus	158	19,750 boxes	49,375
Citrus By-products		27,633 tons	452,763
Total	15,911		$7,016,933
Subtropical Fruits			
Avocados	8,279	1,842,730 flats (13 lb.)	5,620,326
Cactus Fruit	27	30,000 flats (22 lb.)	45,000
Cherimoyas	45	200,000 lbs.	60,000
Dates	19	25,000 lbs.	3,500
Figs	22	88,000 lbs.	10,560
Olives	878	100 tons	24,000
Passion Fruit	16	30,000 lbs.	3,000
Sapotes	16	64,000 lbs.	9,600
Other Subtropicals	15	50,000 lbs.	10,000
Total	9,317		$5,785,986
Other Fruits			
Apples			
Market	522	12,000 boxes (40 lb.)	36,000
Cider		13,000 boxes	5,200
Apricots	120	14,400 boxes (25 lb.)	21,600
Berries			
Strawberries	286	286,000 trays (12 bskt)	858,000
Other	35	21,000 trays (12 bskt)	23,100
Grapes			
Desert - Table	500	9,529 boxes	80,906
Other Table	799	28,500 lugs	35,625
Wine	4,298	2,149 tons	75,215
Peaches	463	173,625 lugs (22 lb.)	303,843
Pears	174	15,000 lugs (24 lb.)	22,500

TABLE No.10 (Continued)

Crop	Acreage	Production	Value
Persimmons	118	41,300 lugs (25 lb.)	46,256
Plums	85	21,250 lugs (27 lb.)	35,062
Walnuts	1,711	11,977 bags (100 lb.)	323,379
Total	9,111		$1,866,776
Vegetables			
Asparagus	22	2,640 crates (38 lb.)	12,038
Beans			
Green, String	979	122,375 crates (60 lb.)	660,825
Green, Lima	354	51,330 crates (60 lb.)	307,980
Broccoli	22	3,080 crates (40 lb.)	7,392
Cabbage	424	21,160 crates (85 lb.)	182,320
Cantaloupes	273	40,950 crates	57,330
Carrots	57	21,660 crates (3 doz.)	48,735
Cauliflower	169	67,600 crates (50 lb.)	67,600
Celery	1,558	1,168,500 crates (60 lb.)	3,213,375
Corn	412	123,600 crates (5 doz.)	216,300
Cucumbers	616	261,800 lugs (30 lb.)	589,050
Lettuce	297	74,250 crates (4 doz.)	222,750
Parsley	31	7,950 crates	15,900
Peas	411	24,660 crates (50 lb.)	147,960
Peppers			
Bell	378	75,600 crates (50 lb.)	453,600
Green Chili	294	58,800 crates (50 lb.)	235,200
Dried Chili	442	442 tons	247,520
Pimiento	77	231 tons	15,910
Yellow Chili	24	144 tons	20,160
Paprika	100	100 tons	56,000
Potatoes, early	210	5,750 sacks (100 lb.)	30,562
Spinach	31	10,850 crates (40 lb.)	16,275
Squash			
Italian & Summer	581	145,250 lugs (25 lb.)	363,125
Banana & Hubbard	96		38,400
Sweet Potatoes	172	34,400 lugs (30 lb.)	61,920
Tomatoes			
Spring & Summer	659	230,650 lugs (32 lb.)	518,962
Fall	2,172	1,303,200 lugs (32 lb.)	3,258,000
Canning		2,220 tons	64,380
Watermelons	296	1,776 tons	44,400
Miscellaneous	290		232,000
Total	11,447		$11,405,969

TABLE No.10 (Continued)

Crop	Acreage	Production	Value
Field Crops			
Beans			
Dry Lima	6,475	12,950 sacks (100 lb.)	233,100
Blackeye	852	12,780 sacks (100 lb.)	191,700
Grain			
Barley	21,539	129,234 sacks (100 lb.)	400,625
Oats	931	5,586 sacks (100 lb.)	20,388
Wheat	418	2,090 sacks (100 lb.)	9,150
Hay			
Alfalfa	3,371	16,855 tons	589,925
Barley	2,672	2,672 tons	48,096
Oats	13,811	13,811 tons	483,385
Ensilage	950	9,500 tons	61,750
Total	51,019		$2,038,119
Animal Husbandry			
Beef Cattle and Calves			5,835,757
Milk and Cream			7,799,164
Chicken Products			
Eggs			6,276,918
Meat			1,526,233
Chicks			94,286
Turkey Products			
Eggs			196,737
Meat			1,019,082
Poults			163,200
Rabbit			
Meat			153,063
Skins			50,325
Horses and Mules			51,644
Hogs			1,019,580
Sheep			48,744
Goats			12,739
Chinchillas			227,500
Fertilizer			408,960
Misc. Animals			29,120
Total			$24,913,102
Miscellaneous			
Market Flowers	736		2,208,000
Flower Bulbs	164		246,000
Flower & Vegetable Seed	24	24,000 lbs.	36,000
Nursery Stock			920,000
Home Plantings			500,000
Honey	15,000 colonies	417,000 lbs.	37,530
Beeswax	18,235 colonies	8,205 lbs.	3,610
Soil & Water Improvement Payments			83,159
Total			$ 4,034,299
GRAND TOTAL			$57,061,184

TABLE 11

IRRIGATION DEVELOPMENTS-SAN DIEGO COUNTY, 1948

(Compiled by the San Diego-California Club in Cooperation with the County Agricultural Commissioner and the Agricultural Extension Service of the University of California)

Irrigation Districts	Remarks	Acres Served
Fallbrook Public Utility District	Domestic & Irrigation	1,000
La Mesa-Lemon Grove-Spring Valley	" " "	4,300
Lakeside	Major Use - Domestic	21
Ramona	Domestic & Irrigation	450
San Dieguito	" " "	1,700
San Ysidro	Major Use - Domestic	346
Rancho Santa Fe	Major Use - Irrigation	3,000
Vista	" " "	7,099
TOTAL		17,916

Mutual Water Companies	Acres Served	Consumers Served
Carlsbad	1,800	1,100
Escondido	13,000	898
Riverview Farms	1,000	313
Lakeside Farms	510	-
TOTAL	16,310	

Water Companies	Acres Served	Consumers Served
California Water & Telephone Co. National City, Chula Vista, Coronado, Palm City, Imperial Beach. So.Bay Area	3,500	12,000

Private Pumping Plants	Acres Served (Est.)
Fallbrook	851
Camp Pendleton (form. Santa Margarita Ranch)	800
San Luis Rey Valley	3,000
Valley Center - Bear Valley	1,000
Escondido - San Pasqual	2,000
Poway	200
Ramona - Santa Ysabel - Julian	700
Mission Valley - Santee - Lakeside	3,000
Alpine - Descanso	250
Sweetwater Valley - Jamacha - Jamul	2,500
Otay	350
s. Juana Valley	750
Cottonwood - Potrero - Campo	750
El Cajon	1,500
Miscellaneous	1,000
TOTAL	18,651
GRAND TOTAL	56,377

TABLE 12

MINERAL PRODUCTION FROM SAN DIEGO COUNTY
(Mineral Resources & Mineral Production During 1947 - State of California
Department of Natural Resources - Division of Mines)

Product	1947 Quantity	1947 Dollar Value	1948 Quantity	1948 Dollar Value	1949 Quantity	1949 Dollar Value
Clays--short tons-------------------	14,533	15,005	35,222	60,922	—	—
Gold--troy ounces-------------------	13	455	8	280	3	105
Sand & Gravel--short tons-----------	1,195,011	1,324,830	1,395,701	1,829,989	1,461,872	1,906,886
Silver--troy ounces-----------------	6	5	3	3	2	2
Stone--short tons-------------------	79,410	196,037	91,570	280,626	71,240	159,645
Unapportioned: (magnesium compounds, pebbles for grinding, pyrophyllite and common salt)------------------	—	346,062	—	422,245	—	360,497
Total Value		1,882,394		2,594,065	--	2,427,135

TABLE 13
ESTIMATED MAXIMUM SAFE YIELD FROM PACIFIC SLOPE BASINS TRIBUTARY TO SAN DIEGO COUNTY

Basin	By surface storage				By underground storage of run-off from tributary areas below surface storage sites			Total safe yield, in acre-ft. per year
	Area of Drainage basin, in sq. miles	Mean seasonal run-off, in acre-ft.	Storage required, in acre-ft.	Safe yield, in acre-feet per year	Area of Drainage basin, in sq. miles	Mean seasonal run-off, in acre-ft.	Safe yield, in acre-feet per year	
Principal Basins								
Santa Margarita River above Ysidora	710	24,050	168,400(2)	14,430(5)	33	2,190	440(9)	14,870
San Luis Rey River above Oceanside	518	55,210	386,500(2)	33,130(5)	47	3,370	670(9)	33,800
San Dieguito River above Del Mar	303	39,340	275,400(2)	23,600(5)	24	1,600	320(9)	23,920
San Diego River above Old Town	376	47,560	332,200(3)	32,500(3)	59	3,900	780(9)	33,280
Sweetwater River above Sweetwater Dam	181	17,540	122,800(2)	10,520(5)	--(8)	--(8)	--(8)	10,520
Otay River above Lower Otay Dam	99	7,650	59,100(4)	3,860(6)	--(8)	--(8)	—(8)	3,860
Tia Juana River above bridge near Nestor	417(1)	41,010(1)	287,100(2)	24,610(5)	44(1)	3,530(1)	710(9)	25,320
Minor Basins								
San Mateo Creek to Aliso Creek	144	12,200	85,400(2)	6,100(7)	97	6,100	470(10)	6,570
Loma Alta Creek to Escondido Creek	126	9,300	65,100(2)	4,650(7)	89	5,100	350(10)	5,000
San Dieguito River to Tecolate Valley	70	5,500	38,500(2)	2,750(7)	108	6,300	490(10)	3,240
Switzer Canyon to Otay River	12	800	5,600(2)	400(7)	153	9,800	790(10)	1,190
Totals		259,760	1,826,100	156,550		41,890	5,020	161,570

(1) Run-off from area in United States only. (2) 700 % of mean seasonal run-off. (3) From analysis by months. (4) Existing storage. (5) 60 % of mean seasonal run-off. (6) From analysis by seasons. (7) 50 % of mean seasonal run-off. (8) Included in minor basins. (9) 20 % of mean seasonal run-off. (10) 10 % of conservable run-off.

Source: From Table 21, Bulletin 48, San Diego County Investigation, State of California Department of Public Works

Table 14

ESTIMATED SEASONAL NATURAL RUNOFF, 1894-95 TO 1946-47 FROM MAIN STREAMS, SAN DIEGO REGION (In Acre-Feet)

(Source: Table 50, Bulletin No. 1, Water Resources of California, State Water Resources Board, 1951)

Season Oct. 1-Sept.30	Santa Margarita River near Ysidora	San Luis Rey River at Oceanside	San Dieguito River at Lake Hodges	San Diego River near Santee	Tijuana River at Marron Damsite
1894-95	145,000	207,000	163,000	168,000	120,000
95-96	1,200	11,300	3,650	4,900	6,300
96-97	18,500	36,800	19,300	21,000	21,900
97-98	400	8,100	1,650	2,480	3,000
98-99	400	6,000	850	1,850	2,300
1899-1900	400	5,500	460	980	720
00-01	11,800	22,600	10,400	8,650	12,200
01-02	2,800	14,100	5,260	7,500	8,600
02-03	11,000	20,800	9,300	15,400	8,900
03-04	400	8,970	2,850	1,270	1,860
1904-05	26,400	55,300	32,800	50,400	39,000
05-06	77,700	135,000	80,100	111,000	81,500
06-07	54,100	104,000	42,900	71,800	59,700
07-08	17,800	34,400	9,530	24,300	14,800
08-09	30,400	64,200	58,500	58,100	44,200
1909-10	29,200	60,800	40,400	33,700	20,700
10-11	22,100	44,000	24,100	19,700	9,920
11-12	13,000	23,600	16,400	23,300	13,700
12-13	1,600	11,400	2,070	10,600	4,480
13-14	21,300	43,700	21,500	25,600	11,700
1914-15	98,700	154,000	73,600	108,000	51,700
15-16	284,000	355,000	310,000	352,000	247,000
16-17	28,800	60,800	32,000	40,600	51,500
17-18	22,500	47,500	25,600	31,000	23,800
18-19	8,700	17,500	3,430	10,800	13,100
1919-20	22,500	46,000	14,500	42,500	45,400
20-21	400	8,660	1,490	7,090	8,700
21-22	123,000	193,000	118,000	202,000	138,000
22-23	17,800	32,300	16,100	22,300	28,700
23-24	5,690	18,700	4,750	8,770	13,200

Table 14, continued

Season Oct. 1- Sept.30	Santa Margarita River near Ysidora	San Luis Rey River at Ocean-side	San Dieguito River at Lake Hodges	San Diego River near Santee	Tijuana River at Marron Damsite
1924-25	4,860	8,470	1,730	8,790	8,450
25-26	18,800	37,600	34,300	36,100	15,200
26-27	93,600	169,000	157,000	185,000	195,000
27-28	6,980	17,400	8,900	11,900	15,100
28-29	3,820	21,400	8,500	15,200	16,400
1929-30	14,200	31,900	15,500	19,200	11,600
30-31	7,000	11,200	4,810	9,770	4,970
31-32	44,300	109,000	71,300	104,000	49,000
32-33	9,660	23,400	17,300	26,900	13,300
33-34	8,400	6,950	1,550	11,500	7,400
1934-35	14,800	21,200	8,520	25,600	16,700
35-36	14,100	22,900	11,100	28,800	11,700
36-37	120,000	217,000	163,000	167,000	134,000
37-38	126,000	162,000	91,600	105,000	74,500
38-39	26,400	55,800	40,100	53,600	40,300
1939-40	23,700	41,400	18,100	27,400	16,600
40-41	121,000	171,000	179,000	246,000	162,000
41-42	20,500	64,900	39,600	34,700	27,900
42-43	82,900	87,000	46,700	51,400	37,200
43-44	39,900	52,800	22,200	45,800	44,300
1944-45	29,800	48,200	17,800	31,100	30,900
45-46	22,700	42,800	16,400	25,200	23,900
1946-47	16,500	19,900	1,510	13,400	6,450
MEAN	37,100	62,200	40,000	52,200	39,000
MEDIAN*	18,800	37,600	17,300	25,600	16,600

* Not given in original table

TABLE 15

MEAN SEASONAL FULL NATURAL RUN-OFFS OF SAN DIEGO COUNTY STREAMS FOR SELECTED PERIODS

(Data from Bulletin 48, San Diego County Investigation by State of California, Department of Public Works, Division of Water Resources-1935)

Stream	drainage basin, in square miles	Seasonal full natural run-off, in acre-feet (Season, October 1 to September 30)			
		Mean for 46 year period 1887-1933	Mean for 19 year period 1914-33	Mean for 19 year period 1895-1914	Mean for 9 year period 1895-1904
Santa Margarita River above Ysidora	743	26,240	31,930	16,560	5,430
San Luis Rey River above Oceanside	565	58,580	71,780	37,370	14,910
San Dieguito River above Hodges Dam	303	39,340	50,680	22,300	7,520
San Diego River above Mission Gorge	377	47,560	65,260	25,930	7,110
Sweetwater River above Sweetwater Dam	181	17,540	25,720	6,860	1,030
Otay River above Lower Otay Dam	99	7,650	10,400	3,330	620
Cottonwood Creek above Barrett Dam	249	25,710	34,920	13,430	5,100
Totals	2,517	222,620	290,690	125,780	41,720
Totals in per cent of 46-year mean, 1887-1933		100	131	57	19

TABLE 16

SUMMARY OF PUBLIC WATER SUPPLY INFORMATION FOR COMMUNITIES IN THE SAN DIEGO BASIN OF CALIFORNIA

(Data from the California State Department of Public Health)

Community	Source of Supply	Treatment	1950 Population	Population Served	M.G.D. Consumption
Capistrano Beach (includes Doheny Park & Dana Point) (San Juan Water Co.)	Wells	Aeration, Chlorination	1,200 est.	1,300 est.	0.05
Carlsbad (Carlsbad Mutual Water Co.)	Wells	Chlorination	4,342 est.	5,000 est.	3.0 (including irrigation)
Chula Vista (and National City) (Calif. Water and Telephone Co.)	Wells, Local Surface, Colorado River	Chlorination	37,637 est.	43,000 est.	9.8 - 19.0
Coronado (Calif. Water and Telephone Co.)	Wells, Local Surface	Softening, Filtration, Chlorination	12,423 est.	21,000 est.	3.1 - 5.3
Del Mar (Del Mar Water Light & Power Co.)	San Dieguito River, Colorado River	Filtration, Chlorination	1,500 est.	1,500 est.	0.25
El Cajon (includes La Mesa)	Wells, Local Surface, Colorado River	Chlorination	35,000 est.	50,000 est.	9.0 - 18.0
Encinitas (San Dieguito Irrigation District)	San Dieguito River, Colorado River	Chlorination	2,600 est.	2,600 est.	0.7 - 4.0
Escondido (City of Escondido)	Wells, Local Surface Supply	Filtration, Chlorination	6,608 est.	7,500 est.	0.4 - 1.1

TABLE 16, Continued

Community	Source of Supply	Treatment	1950 Population	Population Served	M.G.D. Consumption
Escondido (Escondido Mutual Water Co.)	Well, Local Surface Supply	Ammoniation Chlorination	5,700 est.	4,800 est.	4.8 - 14.0
Fallbrook (Fallbrook Public Utility District)	Wells, Colorado River	Chlorination	5,000 est.	5,000 est.	4.0
Jacumba (Jacumba Hot Springs Co.)	Wells	None	600 est.	600 est.	0.04
Laguna Beach (Laguna Beach County Water District)	Colorado River	Filtration, Chlorination	6,188 est.	7,188 est.	1.1 - 3.0
Oceanside (City of Oceanside)	Wells, Colorado River	Chlorination	12,880 est.	13,000 est.	2.6 - 3.6
Pendleton (Federal Govt.)	Wells, Local Surface, Colorado River	Chlorination	- - -	- - -	- - -
Ramona (Ramona Irrigation District)	Wells	None	1,500 est.	1,500 est.	0.08 - 0.18
Rancho Santa Fe (includes Solana Beach) (Santa Fe Irrigation District)	San Dieguito River, Colorado River	Chlorination	2,000 est.	2,000 est.	0.3 - 5.4

TABLE 16, Continued

Community	Source of Supply	Treatment	1950 Population	Population Served	M.G.D. Consumption
San Clemente (City of San Clemente)	Wells	Chlorination, Ammoniation	2,008 est.	3,500 est.	0.5 - 0.9
San Diego (City of San Diego)	Local Surface Supply, Colorado River	Filtration, Chlorination	327,306 est.	370,000 est.	46.0 - 70.0
San Juan Capistrano (Orange Co. Water Works District #4)	Wells	None	795 est.	650 est.	0.02
San Ysidro (San Ysidro Irrigation District)	Wells	Chlorination	3,000 est.	3,000 est.	0.5
Vista (Vista Irrigation District)	San Luis Rey River, Wells	Ammoniation, Chlorination	3,300 est.	5,000 est.	1.0 - 10.0
Totals				553,138	87.24 - 162.34

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TABLE 17

RESERVOIRS LOCATED IN SAN DIEGO COUNTY

(Compiled by the San Diego-California Club in Cooperation with the County Agricultural Commissioner and the Agricultural Extension Service of the University of California)

Name	Owner	Storage Capacity (Ac.Ft.)	Drainage Area (Sq.Mi.)
Barrett	City of San Diego	42,899	249.5
Cholles	" " " "	278	0.03
Lake Hodges	" " " "	37,699	303.0
Savage	" " " "	49,126	98.6
Morena	" " " "	65,800	119.5
San Dieguito	" " " "	1,128	1.2
El Capitan	" " " "	116,500	190.0
San Vincente	" " " "	90,231	75.0
Upper Otay	" " " "	2,793	12.6
Cuyamaca	L.M., L.G. & S.V.I.D.*	11,600	12.0
Eucalyptus	" " "	26	0.13
Mount Helix	" " "	190	0.16
Murray	" " "	5,885	3.75
Murray Hill	" " "	127	0.20
Lake O'Neil	Rancho Santa Margarita	1,390	6.92
Henshaw	San Diego County Water Co.	203,581	205.0
Lake Wohlford	Escondido Mutual Water Co.	7,500	8.1
Fairbanks	Douglas Fairbanks, Estate	100	1.5
Corte Madera	Corte Madera Corporation	50	2.5
Crouch	Charles C. Crouch	40	0.06
Sweetwater, Main	Calif. Water & Tel. Co.	30,973	182.0
Lake Loveland	" " " " "	27,700	98.0
Judson	" " " " "	650	0.19
Henry Jr.	H. F. Schnell	196	9.1
Mary Joe	H. F. Schnell	135	9.3
Upper 4-S	4-S Ranch	63	1.9
Wuest	Wm. Kootz & Wuest Estate Co.	280	29.0
Monte Vista Ranch	Sefton Investment Co.	21	0.10
Pechstein	Vista Irrigation District	200	0.11
TOTALS		697,161	1,619.45

* La Mesa, Lemon Grove and Spring Valley Irrigation District.

Report Prepared by
San Diego County Water Authority

WATER RESOURCES

The area within Region 9 of the California Pollution Board includes San Diego County and a small fringe area along the northern boundary of San Diego County in Orange and Riverside County. Except for portions of the Santa Margarita and Tijuana Rivers, all the major streams in the **Region** lie within San Diego County.

General Description. The San Diego Region, with an area in excess of 5000 square miles, lies in the southwesterly corner of the United States and is about the size of the State of Connecticut. From an initial point located at the intersection of the international boundary with the Pacific Ocean, it extends 90 miles northwesterly along the Pacific coast and about the same distance easterly to Imperial County, California. This land area is cut by a rugged chain of mountains known as the Peninsula Range, which emerge from the San Jacinto Range and the Santa Ana Range in Riverside County and extend southwesterly, roughly paralleling the coastline, to form the backbone of the lower California peninsula. Of the entire area, 3000 square miles, or 70 per cent, lie on the Pacific slope and 1300 square miles, or 30 per cent, on the easterly slope, draining into the Salton sink.

General Topography and Geology.* The Region is composed of four distinct physiographic zones. Starting from the coast and proceeding eastward, they are: (1) the coastal plains, (2) inland valleys, (3) mountains, and (4) desert valleys and mountains.

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*Quoted from U. S. Bureau of Reclamation report on All-American Canal Connection - San Diego Aqueduct.

The coastal plains area comprises a strip some 10 miles in width, adjacent to the coast. The land is elevated 100 to 300 feet above the sea at the coast and rises to about 500 feet at the easterly edge of the plains. Numerous streams cross this area and have dissected it into a rough, rolling series of hills and ridges whose axes are roughly normal to the coastline.

The inland valley belt extends an additional 10 to 12 miles inland and is characterized by a series of narrow valleys with a general northwest-southeast trend, enclosed on the westerly and easterly sides by ranges of hills. These valleys are further characterized by being progressively higher in elevation from west to east. They have been formed by a combination of regional tilting and step faulting, which is typical of the entire California area. Small intermittent streams, which rise in this belt and flow in a southwesterly direction to the ocean, have cut deep canyons through the ranges of hills surrounding the valleys.

The mountains to the east of the inland valleys rise gradually from the inland valley area to the crest, located some 40 to 50 miles inland. This mountainous area has a general crest elevation of 4000 to 5000 feet, with some peaks reaching 6500 feet.

All major streams of the region rise in the mountainous area and have cut deep, sharp canyons into the country rock. These streams generally have steep gradients near their headwaters and have comparatively flat gradients by the time they reach the inland valley belt.

Easterly from the crest of the mountains, the terrain breaks sharply and steeply to the floor of the adjacent desert. This break is in reality a fault scarp which marks, in general, the eastern limit of the uptilt and faulting which have produced the mountains. Drops of 3000 feet within a horizontal distance of 1 to 2 miles are common. The desert area is a generally eastward sloping plain, interspersed with mountains and mountain ranges. These mountain ranges again have a trend roughly paralleling the coast line.

Several streams have their source east of the crest of the mountains, and have a very steep gradient to the floor of the desert. The area drained within the mountainous region by these streams is very limited and does not contribute much runoff; consequently, the water is soon lost in the sand when the dry floor of the desert is reached. However, during cloudbursts, which occur in the summer, raging torrents are sent down the normally dry desert channels of the streams, flooding the desert stream channels for considerable distances beyond the edge of the mountains.

Precipitation. A continuous record of rainfall at San Diego City from 1850 to the present, a period of 100 years, is available from the U. S. Weather Bureau. This record shows an average rainfall at this point of 10.03 inches, and is typical of the amount of rainfall along the entire County coast. The average annual precipitation increases to the east with the higher elevations until at the crest of the mountains the annual rainfall reaches 40 to 50 inches. The rate of rainfall decreases rapidly east of the mountains to from 3 to 4 inches per year within a distance of 30 miles.

The amount of precipitation varies considerably from year to year. At the San Diego Station, the annual precipitation has varied from a low of 3.75 inches in the year 1876-77 to a high of 25.97 inches in 1883-84. The annual rainfall at San Diego and the accumulated departures from the mean annual precipitation of 10.03 inches are shown on Figure 1. The plotting of the last five years shows very clearly the sub-normal rainfall which has occurred at this station during these years, averaging only 8.29 inches. Comparing the record for these years with the past record, a possible period of dry years which may continue for from 13 to 22 years is indicated.

A large variation also exists in the distribution of precipitation through the year. On the average, about 75 per cent of the annual fall occurs in the four months of December to March, inclusive. Practically no rainfall occurs during the four summer months.

Rivers. The seven principal streams on the Pacific coast slope of the Region are the Santa Margarita, San Luis Rey, San Dieguito, San Diego, Sweetwater, Otay, and the Tijuana. The drainage basins of all streams except the latter lie within San Diego County, although the Santa Margarita, which, while rising in San Diego County, crosses for a short distance into Riverside County and then returns. A large part of the Tijuana drainage basin lies in Mexico.

The streams all rise in the mountains, 40 to 50 miles to the east, and flow generally southwesterly. The mountains receive only a very small portion of their winter precipitation as snow, so no large runoffs from snow melt are available. Such snow as does fall is occasional and light, and usually disappears by evaporation with very little effect on stream runoff. Climatological conditions causing drought or floods at any time will, in general, be common to all streams.

Stream Flows. The drainage area at the lowest dams, or dam sites, on the major rivers of the Region is given in Table 1, together with the mean seasonal runoffs from the drainage areas above these points.

TABLE 1

MEAN SEASONAL RUNOFF - MAJOR STREAMS OF REGION 9
(Average of 57 years, 1887 to 1944)

Stream	Drainage area -- square miles	Mean Seasonal Runoff		
		acre-feet	ac.ft. per sq.mil	Inches on drainage area
Santa Margarita at Ysidora	743	26,240*	36*	0.7*
San Luis Rey near Bonsall	514	55,210*	101*	1.9*
San Dieguito at Hodges Dam	299	42,650	143	2.7
San Diego at Mission Gorge	377	49,410	131	2.5
Sweetwater at Sweetwater Dam	181	18,110	100	1.9
Otay at Lower Otay Dam	99	7,650*	77*	1.4*
Cottonwood Creek at Barret Dam	249	25,710*	103*	1.9*

* 1887 to 1933, inclusive. Taken from Table 7, Bulletin 48, San Diego County Investigation, Division of Water Resources, State of California.

In the above table, the mean seasonal runoff is also expressed in terms of inches on the drainage areas, and shows the very small proportion of the average annual precipitation, ranging from 10 to 50 inches, which appears as flow in the stream.

A comparative study of rainfall and runoff in the San Diego River Basin appears in a staff report to the San Diego County Water Authority Board, dated December, 1945, entitled "Water Resources and Developed Water Supplies of San Diego County". Figure 2, reproduced from that report, shows the annual rainfall over this area, together with the runoff which would have occurred under natural conditions at Mission Gorge, plotted to the same scale and units. This chart shows graphically the small and erratic portion of precipitation appearing as runoff. The mean average precipitation over the area for the period from 1900 to 1944 is 27.60 inches. Of this amount, only a flow equivalent to

2.63 inches over the drainage area appears as runoff. This indicates a loss of about 25 inches, or 90 per cent, of the total precipitation by evaporation, seepage and plant growth. The chart also shows that runoff does not vary directly with precipitation, but decreases at a more rapid rate as precipitation decreases, until practically no runoff occurs in this basin when the average annual precipitation is less than 14 inches.

Safe Yield of Rivers. The runoffs of all major streams in the district in their lower reaches are intermittent, and without the construction of reservoirs they cannot be relied upon for a firm water supply. With the construction of reservoirs and their later filling, the flow can be regulated so as to give a continuous firm supply. This supply is usually termed the safe yield of the reservoir. In the computation of the safe yield of a given reservoir for municipal water supplies it is common practice to assume the most severe drought period which occurred in the records of the stream. Because of the small amount of precipitation falling in this area, and its erratic distribution, extremely large reservoirs are required to store and carry over surplus stream flow from flood years for use in periods of drought. It has been found that storage capacities of 700 per cent of the average seasonal runoff are required to completely regulate local streams and to supply maximum safe yields from reservoirs. However, with such large amounts of storage, evaporation losses are excessive, averaging up to 40 per cent of the mean seasonal runoff and leaving 60 per cent as usable water. This means that only about 6 per cent of the total average precipitation is capable of being used.

The Division of Water Resources of the State of California has estimated a maximum safe yield from the Pacific slope basin's tributary to San Diego County, by surface and sub-surface storage, of 161,570 acre-feet per annum (1). This includes only the runoff from that part of the Tijuana Basin lying in the United States. San Juan Creek, lying entirely outside San Diego County, is also within the Region.

Overall Water Situation. From the standpoint of natural water resources, the Region is believed to be one of the poorest in California. This is due in part to low and very erratic rainfall and in part to the small area and other characteristics of the west slope watersheds, which have an average length from mountain top to ocean beach of only about 45 miles and are generally all affected at a given time by either cycles of drought or periods of above-normal rainfall.

The coastal plains and inland valley areas of San Diego County, exclusive of the Santa Margarita Ranch, contain about 500,000 net acres of arable land, and within the entire Region the arable lands might total acres.

The present average water use in San Diego County totals only about 160,000 acre-feet per annum. The total potential water supply of the County, including that from the Colorado River, is about 260,000 acre-feet per annum. Of this amount, 115,000 acre-feet is normally available from reservoirs and wells, and 70,000 acre-feet is being supplied from the newly constructed (1945-47) San Diego Aqueduct, while about 75,000 acre-feet remains to be developed -- 25,000 acre-feet from local watersheds, and 50,000 acre-feet from the Colorado River by enlarging the present Aqueduct. Thus the Colorado River is being relied upon to provide 46 per cent of the total potential water supply of the County

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(1) Table 21, Bulletin 48, San Diego County Investigation, Division of Water Resources, State of California.

The coastal belt area of San Diego County includes practically all the constituted water agencies in the County. The net acreage of arable lands in this area totals 376,800 acres (See Table 3). Practically all of the presently constituted water-using agencies in the County are located here, and their net areas total 160,000 acres, of which only a portion is now developed and using a full water supply. The undeveloped resources of the County are assumed to be all earmarked for use by these organized agencies.

Under this assumed program of water use, the organized water agencies would have sufficient water to expand their several areas, by annexations, to ultimately include a total gross area of about 215,000 acres. In addition, it is roughly estimated that about 15,000 acres of river-bottom land is being irrigated by individual land owners having riparian rights.

It is clear from the above that there are some 210,000 gross acres of arable lands in the coastal belt of the County and about 150,000 gross acres in the inland valley area, which cannot be intensively developed due to the lack of presently feasible sources for obtaining additional water supplies. This is 60 per cent of the entire arable lands capable of being intensively developed. It is evident that San Diego County, after fully developing the local water supplies and bringing in the full entitlement of Colorado River water, will have only about one-half of the water needed for a full development.

Water Agencies in San Diego County. A map has been prepared, and is appended to this report, showing the westerly 30 miles of San Diego County, which includes the Coastal Plain and Inland Valley areas of the County. This map, entitled "Areas in San Diego County Served by the San Diego Aqueduct and its Branches", shows agencies served by the aqueduct. The areas within the agencies comprising the Authority are shown shaded, and include 124,286 acres. The area of non-member organized water districts lying in the coastal plain area is 60,290 acres, making a total gross area served by organized water district of 184,576 acres, about 10 per cent of the total 1,920,000 acres in the County west of the mountain divide. The area of each individual agency is given in Table 2.

TABLE 2

AREAS OF ORGANIZED WATER AGENCIES LYING WITHIN THE COASTAL PLAINS AREA GENERALLY WEST OF THE SAN DIEGO AQUEDUCT

AREA OF MEMBER AGENCIES OF AUTHORITY

		Gross Area	
I	Chula Vista	3,363	
II	Escondido, City of	1,800	
III	Fallbrook Public Utility District	5,000	
IV	Lakeside Irrigation District	2,008	
V	La Mesa, Lemon Grove & Spring Valley Irrig. Dist.	22,011	
VI	National City	3,464	
VII	Oceanside, City of	6,402	
VIII	San Diego, City of	66,141	
IX	San Dieguito Irrigation District	3,993	
X	Santa Fe Irrigation District	10,106	
	Total		124,288 acres

AREA OF OTHER WATER AGENCIES IN COASTAL PLAIN AREAS

1.	Bennett Mutual Water Company	190	
2.	Carlsbad Mutual Water Company	7,090	
3.	California Water & Tel. Co. - Coronado Division	5,630	
4.	Del Mar Water, Light & Power Company	700	
5.	Escondido Mutual Water Company (2)	11,430	
6.	Lakeside Farms Mutual Water Company	970	
7.	Riverview Farms Mutual Water Company	1,290	
8.	San Luis Rey Heights Mutual Water Company	1,720	
9.	San Ysidro Irrigation District	530	
10.	South Bay Irrigation District (1)	9,840	
11.	Vista Irrigation District	18,050	
12.	U. S. Navy, North Island	1,540	
13.	U. S. Army, Fort Rosecrans	1,310	
	Total		60,290 acres
	TOTAL ORGANIZED AREAS		184,578 acres

(1) Excluding Chula Vista
(2) Excluding City of Escondido

Arable Lands. The lands lying within the area of this map which have been designated as non-arable by the United States Department of Agriculture in its soil classification survey of the County, are shown crosshatched, leaving the arable areas clear. The division of these arable lands between the Coastal Plains area lying generally west of the San Diego Aqueduct and its extension and the Inland Valley area to the east of the Aqueduct is given in Table 3. This table shows a net usable area of about 500,000 acres, of which 376,800 acres lie within the Coastal Plains area.

TABLE 3

ARABLE LANDS - COASTAL PLAINS AND INLAND VALLEY AREAS OF SAN DIEGO COUNTY

(Exclusive of Santa Margarita Ranch)

COASTAL PLAINS AREA - ARABLE LANDS		
Authority Agencies	124,288 acres	
Other organized water districts	60,121 "	
Arable lands outside organized districts	258,901 "	
Total gross area of arable lands in Coastal Plains area	443,310 "	
Deduct 15% for roads, water courses, inaccessible lands, etc.	66,510 "	
Net usable lands in Coastal Plains area		376,800 acres
PRINCIPAL INLAND VALLEY AREAS - ARABLE LANDS		
Authority Agencies	none	
Other organized Water Districts	1,500 "	
Arable lands outside organized districts	150,000 "	
Total gross area of arable lands in the Inland Valley area	151,500 "	
Deduct 20% for roads, water courses, inaccessible lands, etc.	30,300	
Net usable lands in Inland Valley area		121,200 acres
TOTAL USABLE LANDS IN COASTAL PLAINS AREA AND INLAND VALLEY AREA		498,000 acres

Existing Reservoir Supplies. For agencies within the Authority the water supplies of the cities of San Diego, Chula Vista, Escondido, National City, and the La Mesa, Lemon Grove and Spring Valley Irrigation District, San Dieguito Irrigation District, and the Santa Fe Irrigation District are obtained in part, or in whole, from stream runoff stored in reservoirs. The City of Oceanside, Fallbrook Public Utility District, and the Lakeside Irrigation District have no surface water supplies. The reservoirs of the several agencies and their capacities are contained in Table 4. The Quantity of water stored in these reservoirs on May 1, 1951 totals about 77,260 acre-feet, or about 17 per cent of their combined capacity.

For areas outside the Authority, the Vista Irrigation District and the Escondido Mutual Water Company obtain their supplies from Lake Henshaw and Lake Wohlford, with some underground supplemental water. The City of Coronado and the Del Mar Water District obtain their water from the City of San Diego Reservoirs through contractual agreements. The San Ysidro Irrigation District and the Carlsbad Mutual Water Company obtain water exclusively from wells.

TABLE 4

EXISTING LOCAL WATER SUPPLY RESERVOIRS OF AUTHORITY AGENCIES AND THEIR ESTIMATED YIELD

Agency and Reservoir	Reservoir Capacity acre-feet	Estimated Safe Yield Normal Use ac.ft./yr.
CHULA VISTA & NATIONAL CITY (Calif. Water & Tel. Co.) (Sweetwater Division)		
Sweetwater	29,065	
Loveland	25,400	8,000
Total....................	54,465	8,000
LA MESA, LEMON GROVE & SPRING VALLEY IRRIGATION DISTRICT		
Cuyamaca	11,595	1,000
El Capitan	10,000 (1)	1,790
San Vicente	3,000 (1)	0 (4)
Murray (less 5000 to S.D.)	880	0
Total	25,475	2,790
CITY OF SAN DIEGO		
Morena	50,131	5,600
Barrett	47,798	5,370
Upper Otay	2,565	
Lower Otay	56,326 (3)	4,250
Chollas	328	0
El Capitan (less 10,000) (to La Mesa)	106,448	11,200 (5)
San Vicente	87,234 (6)	5,930
Murray	5,000 (2)	0
Hodges	33,483 (3)	6,270
San Dieguito	1,131 (3)	0
Total....................	385,449	38,620
Combined Total..................	465,389	49,410

(1) Usable storage by La Mesa, Lemon Grove & Spring Valley Irrigation District through agreement.
(2) Usable storage by City of San Diego through agreement.
(3) Subject to City's outstanding commitments to several irrigation districts and water companies.
(4) Safe yield included in figure for City of San Diego.
(5) Excluding 1790 acre-feet per year for La Mesa.
(6) Excluding 3000 acre-feet per year for La Mesa.

Existing Ground Water Supplies. The city of Oceanside, the Fallbrook Public Utility District, and the Lakeside Irrigation District obtain all their supplies from wells located in nearby river valley bottoms. The other agencies augment their surface supplies, as required, from underground sources. The river basins in which the wells are located, and their pump capacities and estimated yields are given in Table 5. Water levels in these well fields are now below normal. The City of San Diego has not drawn from its wells for some time.

TABLE 5

EXISTING UNDERGROUND LOCAL WATER RESOURCES OF AUTHORITY AGENCIES

Agency and River Basin	Installed Pump Capacity g.p.m.	Estimated Safe Yield Normal ac.ft./yr.
CHULA VISTA & NATIONAL CITY (Calif. Water & Telephone Co.) (Sweetwater Division)		
Sweetwater River Basin	2,500	1,200
FALLBROOK PUBLIC UTILITY DISTRICT		
Santa Margarita River Basin	1,500	0
San Luis Rey River Basin	7,100	2,200
LAKESIDE IRRIGATION DISTRICT		
San Diego River Basin	200	100
LA MESA, LEMON GROVE & SPRING VALLEY IRRIGATION DISTRICT		
San Diego River Basin	4,500	2,000
CITY OF OCEANSIDE		
San Luis Rey River Basin	3,500 to 4,000	2,500
CITY OF SAN DIEGO		
San Diego River Basin	0	0
		8,000

The combined yields of the surface and the underground sources of water supplies of Authority agencies, as given in detail in Tables

4 and 5, are summarized in Table 6 on the condition that the storage reservoirs are replenished by a heavy runoff in the near future.

TABLE 6

SUMMARY OF ESTIMATED SAFE YIELD OF LOCAL WATER DEVELOPMENT OF AUTHORITY AGENCIES

Agency	Safe Yield Under Normal Conditions		
	Surface ac.ft./yr.	Underground ac.ft./yr.	Total ac.ft./yr.
Chula Vista and National City (Calif. Water & Tel. Company)	8,000	1,200	9,200
Fallbrook Public Utility District	none	2,200	2,200
Lakeside Irrigation District	none	100	100
La Mesa, Lemon Grove & Spring Valley Irrigation District	2,550	2,000	4,550
City of Oceanside	none	2,500	2,500
City of San Diego	35,710	0	35,710
Total....................	46,260	8,000	54,260

Future Developments of Remaining Local Water Resources. The local stream systems of San Diego County, with the exception of the Santa Margarita River, have all been partially developed by the construction of eleven reservoirs, most of which only partially control the flows of the respective streams. The water developments now existing on these streams, in general, include the least costly and most conveniently located reservoirs. Further reservoir construction will grow increasingly costly as conservation storage approaches full utilization of flood flows.

Opportunities for future developments of additional water supplies exist on Cottonwood Creek, in the Tijuana River Basin, and on the San Diego and San Dieguito Rivers. The construction of additional conservation works on these streams has long been contemplated. Data on the works required for the purpose are included in the following Table 7, which shows the estimated safe yield of these works to be 24,600 acre-feet per year.

TABLE 7

PLANNED FUTURE DEVELOPMENTS FOR SAN DIEGO COUNTY STREAMS

River	Estimated Cost (as of 1948)	Estimated Additional Yield ac.ft./yr.	Cost per Acre-Foot of Added Yield
COTTONWOOD SYSTEM			
Barrett Heightening	$3,500,000	5,600	$625
SAN DIEGO RIVER SYSTEM			
Mission Project	3,000,000	2,300	1,304
SAN DIEGUITO RIVER SYSTEM			
Sutherland Dam Completion	2,350,000		
Sutherland Conduit	1,350,000		
Super Hodges	7,300,000		
Hodges Pumping Plant and Pipe Line	3,500,000		
Total	14,500,000	18,400	788
GRAND TOTAL CITY OF SAN DIEGO SYSTEMS	$21,000,000	26,300	$ 798
SAN LUIS REY			
Bonsall Site	7,500,000	10,280	730
	$28,500,000	36,580	$ 779

The Marron development on the Tijuana River has been omitted from the above tabulation because its international location makes the benefits from it uncertain. Data on proposed San Diego city conservation works from memorandum "Future Water Requirements of San Diego" by Fred Pyle, dated April 27, 1948.

A site exists for the development of an additional reservoir on the Tijuana River, known as the Marron Reservoir site. This reservoir is located on the international boundary between Mexico and the United States and could only be developed under the existing treaty between the two countries. This would be a time-consuming process, and the division of waters between Mexico and the United States cannot be estimated at this time. For this reason, the limited supply available from this source has been omitted from this study.

The San Luis Rey and the Santa Margarita Rivers in the northern part of the County are the only other major rivers in the County having reservoir sites capable of development. The San Luis Rey River has reservoir sites at Bonsall and at Monserate, of which the first is favored. Active studies of this site by Oceanside, Fallbrook, and other agencies are now in progress.

The Santa Margarita River flows only a short distance in San Diego County before entering the military reservation of Camp Pendleton.

SAN DIEGO AQUEDUCT

History. Following the declaration of war in 1941, a large increase in population occurred in the San Diego area due to the expansion of war industries and military establishments. It was soon apparent that the local water supplies would be insufficient to meet the increased demand for water. The further development of potential local supplies would require more time than was available, and their yield would be uncertain even after completion, due to the extreme variation in runoff from year to year. It was therefore realized that the solution to the immediate water problem was to bring water to this area from the Colorado River. The City and County, therefore, in May of 1943, entered into contracts with the Bureau of Reclamation for investigations to determine the feasibility and location of an aqueduct to bring Colorado River water to the San Diego area. Work was begun by the Bureau in the Fall of 1943, and a preliminary report submitted in September, 1944. This report indicated that an aqueduct could be constructed from the west portal of San Jacinto Tunnel to the San Vicente Reservoir of the City's water system, with a capacity of 85 c.f.s. for a cost of $17,100,000 and an aqueduct for double this capacity for a cost of $21,600,000.

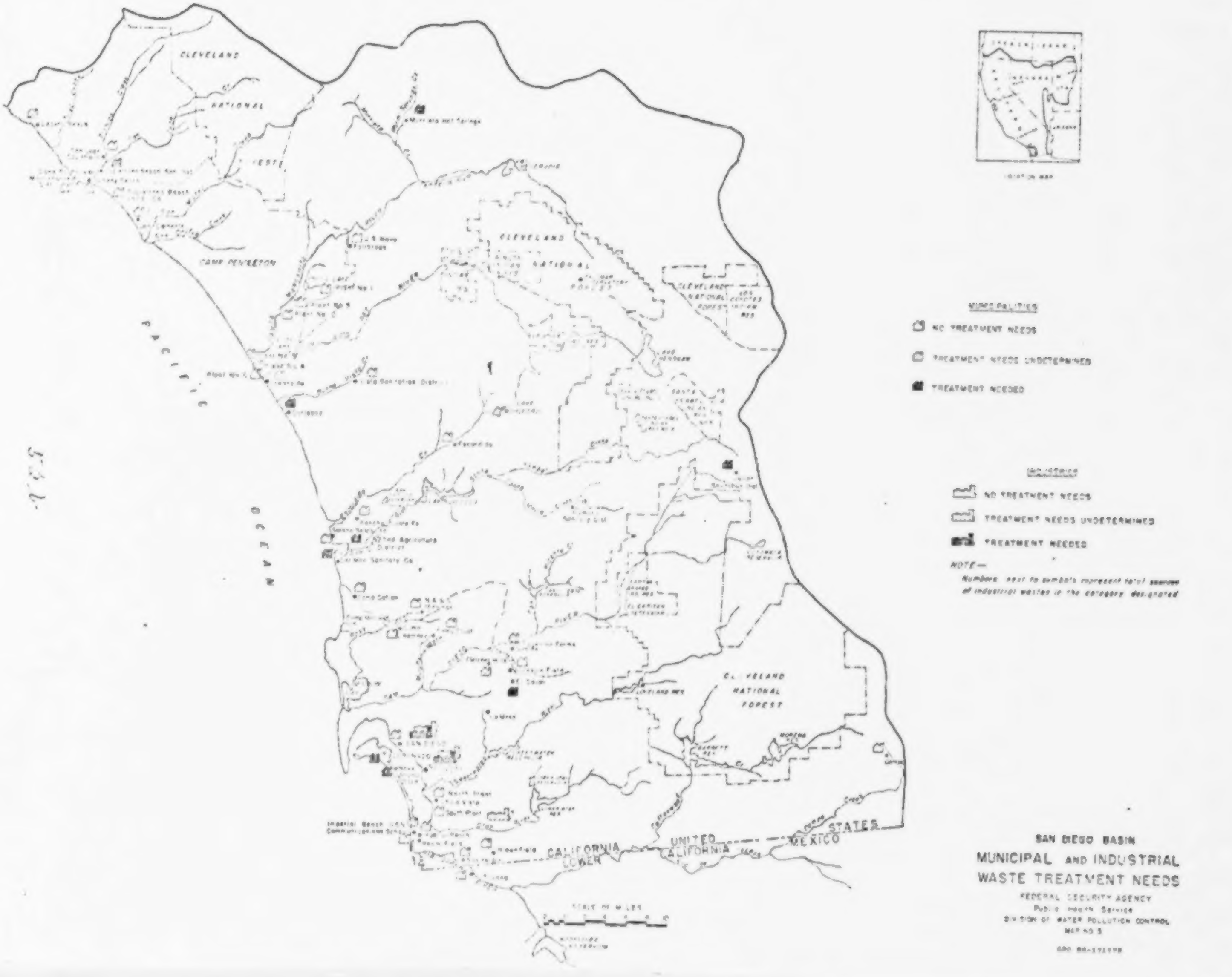
In the Fall of 1944, it became very apparent that immediate steps must be taken to increase the water supply if the area was to continue the work so vitally necessary to the war effort. The President of the United States appointed a special inter-departmental committee to study the problem and report the best means of meeting the emergency. The committee recommended the immediate construction of the San Diego Aqueduct with a capacity of 85 c.f.s., except for tunnels which should have full capacity. The committee further recommended that the local agencies immediately seek annexation to the Metropolitan Water District in order that the proposed aqueduct might fit in to a permanent solution of the water problem of San Diego County. The committee's recommendations were approved by the President of the United States, and directives were issued at once to the Navy and the Bureau of Reclamation to make active preparations for the beginning of construction.

The Bureau of Reclamation was designated as the design agency and the United States Navy as the construction agency. The first contract was awarded by the Navy Department on May 18, 1945. The work was divided into a total of eight schedules, the last of which was awarded on November 20, 1945. The first water passed through this aqueduct and was discharged into San Vicente Reservoir on December 11, 1947. Since that time the aqueduct has been carrying its full capacity of water, which at first was all discharged into the City of San Diego's San Vicente Reservoir, but as the construction of branch lines was completed by the Authority, water was also distributed to the other Authority agencies.

Membership in the Metropolitan Water District. The San Diego Aqueduct under the War Emergency Act could obtain water from the Metropolitan Water District for military use through its connection at San Jacinto Tunnel. However, upon the termination of war, this Act would cease to function, and thereafter water could only be obtained through annexing the Water Authority to the Metropolitan Water District. Following the signing of the City-Navy Contract on October 17, 1945, under which the Government agreed to complete the Aqueduct at its expense and the City agreed to repay the true cost of the Aqueduct over a period of thirty years, active steps were taken towards annexation to the Metropolitan Water District. On November 2, 1945, a resolution by the Authority Board appointed a joint negotiating committee to meet with the District's staff for the purpose of arranging terms of annexation. These negotiations continued, together with direct negotiations between members of the Board and the Metropolitan Water District Board, until

March 1946 when a resolution was unanimously adopted containing a formal application to the Metropolitan Water District for consent to annex the Authority to that District. Final details were completed; an election of Authority voters was held on November 5, 1946, and the Authority became a member of the District on December 17, 1946. Under the terms of annexation, the Metropolitan Water District agreed to take over the northerly one-half of the San Diego Aqueduct, to reimburse the Authority for its cost, to maintain this section, and to make such enlargements as might be required in the future to supply demands of the Authority.

Description and Capacity of the Present Aqueduct. The San Diego Aqueduct is constructed as a gravity conduit extending from the west portal of the San Jacinto Tunnel on the Colorado River Aqueduct to the San Vicente Reservoir, a total distance of 71.1 miles. A regulating reservoir, with a capacity of 1800 acre-feet, is located about two miles distant from the takeoff at San Jacinto Tunnel. The Aqueduct, in general, consists of reinforced concrete pipe from 48 inches to 96 inches in diameter. The section of line from its beginning to the regulating reservoir was designed for a capacity of 200 c.f.s. All other pipe lines were designed for a capacity of 85 c.f.s. There are seven tunnels as part of the conduit, which were designed for a capacity of 165 c.f.s., but can probably carry a much larger flow. Suitable structures were constructed at the outlet and inlet ends of the tunnels so that the capacity of the Aqueduct could be increased to the tunnel capacity by installing a duplicate pipe line along the present sections of pipe. Following the completion of the Aqueduct, tests were made under the direction of Mr. Fred C. Scobey, a specialist in this work, which tests


CLEVELAND NATIONAL FOREST
CAMP PENDLETON
PACIFIC OCEAN
Murrieta Hot Springs
Oceanside
Vista Sanitation District
Escondido
Imperial Beach U.S.N. Communications School
CALIFORNIA
LOWER CALIFORNIA
UNITED STATES
MEXICO
SCALE OF MILES
LOCATION MAP
MUNICIPALITIES
NO TREATMENT NEEDS
TREATMENT NEEDS UNDETERMINED
TREATMENT NEEDED
INDUSTRIES
NO TREATMENT NEEDS
TREATMENT NEEDS UNDETERMINED
TREATMENT NEEDED
NOTE—
Numbers next to symbols represent total sources of industrial wastes in the category designated

SAN DIEGO BASIN
MUNICIPAL AND INDUSTRIAL
WASTE TREATMENT NEEDS
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO 5

GPO 88-172778

53.b.

indicated that the capacity of the Aqueduct would far exceed the design capacities. The present conduit is carrying 106 c.f.s., about 25 percent in excess of the design capacity.

Cost of Present Aqueduct and Method of Repayment to U. S.

Following the termination of war, the Navy Department proposed to stop work on the San Diego Aqueduct and to cancel all contracts then in effect. City and Authority representatives conferred with Navy officials in Washington, which conference resulted in a contract being signed on October 17, 1945, by the City Manager of San Diego and the United States Navy. Under this contract the Government agreed to complete the San Diego Aqueduct at its expense and to transfer the Aqueduct to the City after its completion, for its operation and maintenance. The City contracted to pay to the Government the true cost of the Aqueduct, estimated at about 15 million dollars, at an annual cost of $500,000 over a period of thirty years. This contract was later assigned to the Authority, which agency has now assumed the primary obligations under the contract. The true cost has not been determined, since the Aqueduct is still incomplete; there being rights of way not yet acquired. Transfer to the Authority was made by an interim agreement under which payments to the Government at one-half the contract amount began January 1, 1948, payable in monthly installments. This agreement will continue until the final completion date, when the terms of the original contract will become effective. The northerly one-half of the Aqueduct has been transferred for operation and maintenance to the Metropolitan Water District, which in turn pays the Authority one-half of the charges due the Government.

Cost of Aqueduct Enlargement. The present cost of enlarging the Aqueduct on the basis of installing a second barrel of equal size and parallel to the original pipe line, as contemplated in the original design of the Bureau of Reclamation, is estimated at about $14,000,000, of which $6,700,000 would be required for the southerly section of the Aqueduct now administered by the Authority. This present cost has been estimated by using the quantities developed by the Bureau, and the unit costs of the contract items corrected to present day costs.

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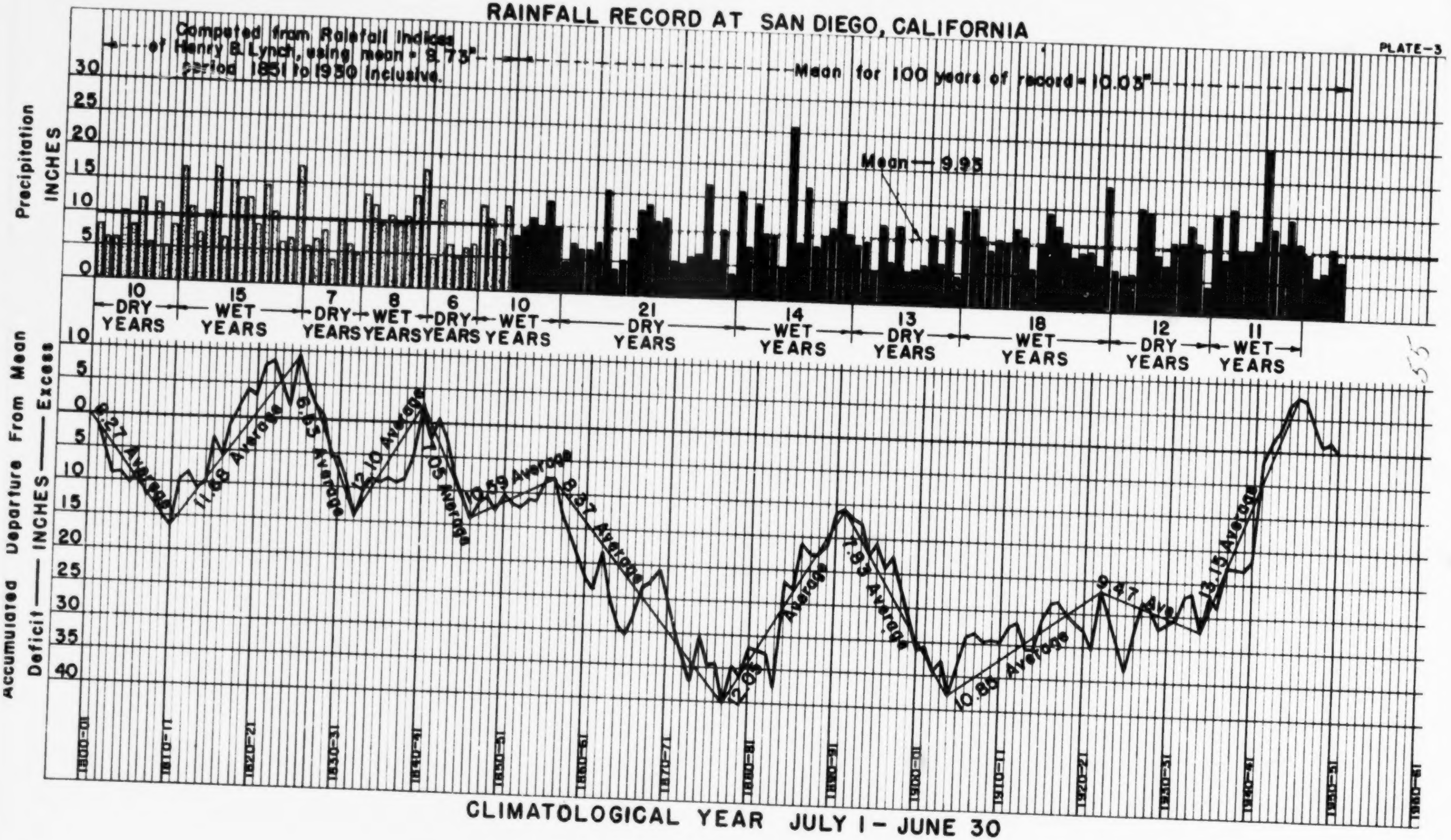
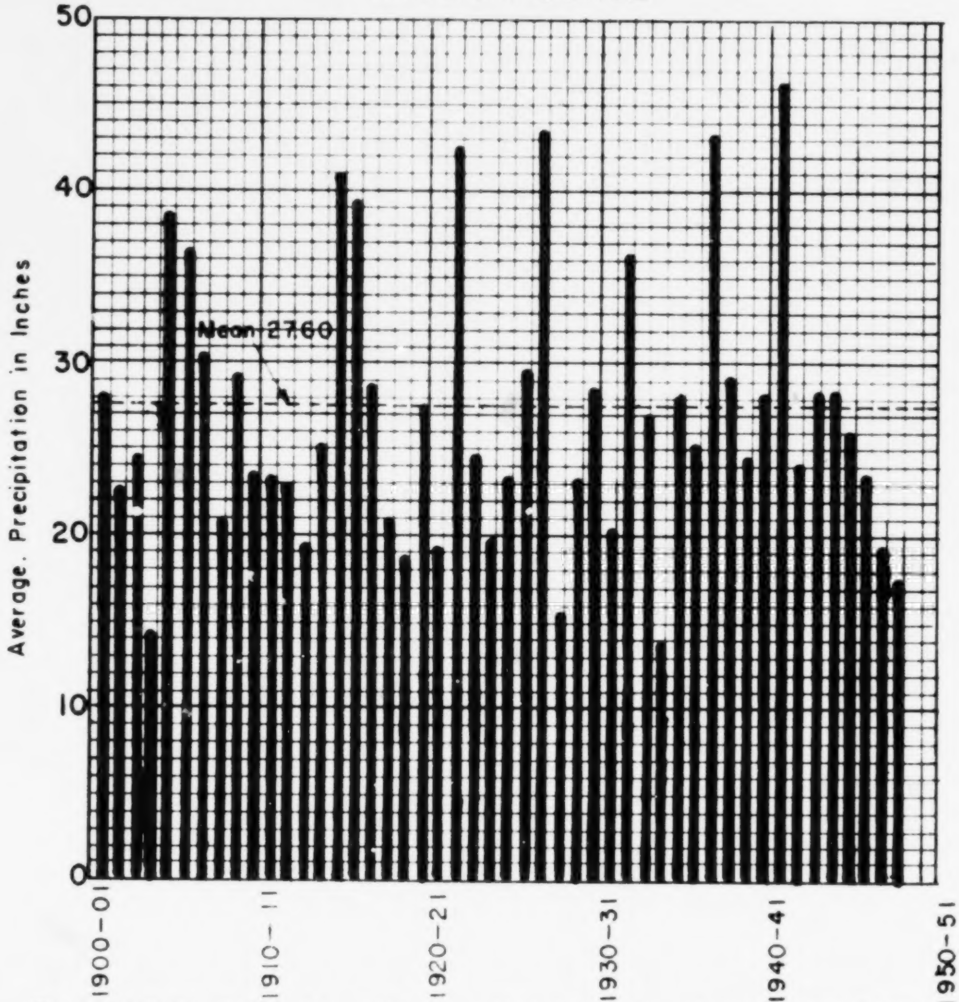
PLATE-3

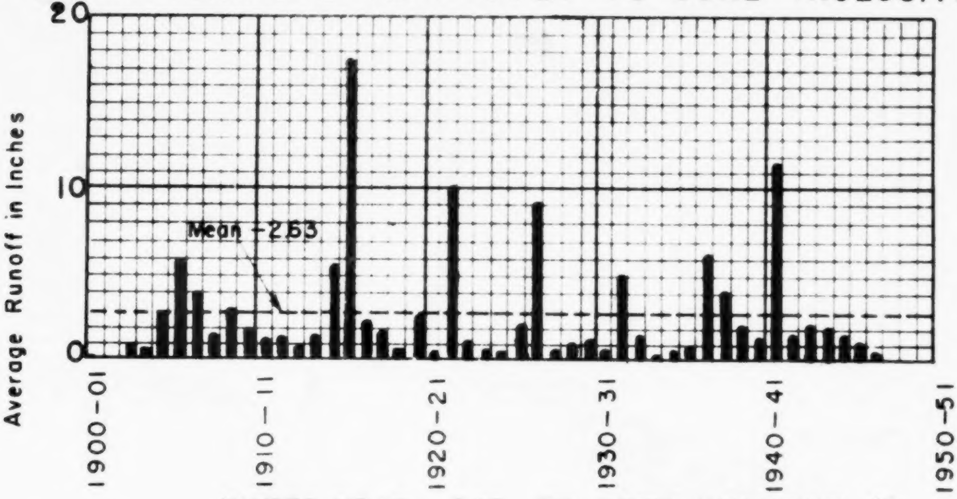
RAINFALL RECORD AT SAN DIEGO, CALIFORNIA



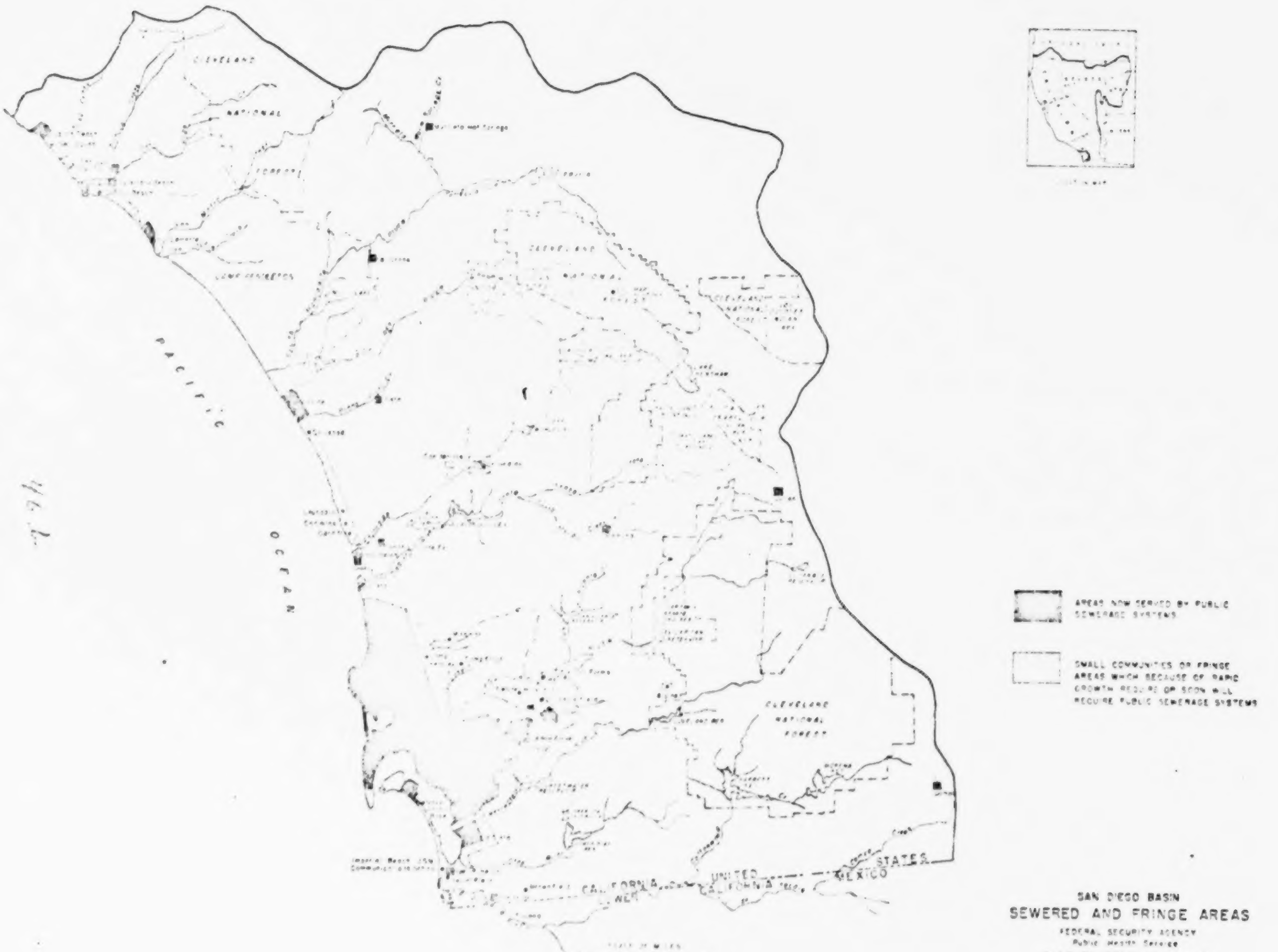
COMPARISON
PRECIPITATION, (AVERAGE CUYAMACA AND GROSSMONT) AND FULL NATURAL FLOW SAN DIEGO RIVER
MISSION GORGE



CLIMATOLOGICAL YEAR JULY TO JUNE INCLUSIVE



WATER YEAR OCT TO SEPT INCLUSIVE


AREAS NOW SERVED BY PUBLIC SEWERAGE SYSTEMS
SMALL COMMUNITIES OR FRINGE AREAS WHICH BECAUSE OF RAPID GROWTH REQUIRE OR SOON WILL REQUIRE PUBLIC SEWERAGE SYSTEMS
PACIFIC
OCEAN
CLEVELAND
NATIONAL
FOREST
CLEVELAND
NATIONAL
CLEVELAND
NATIONAL
FOREST
UNITED
STATES
MEXICO
CALIFORNIA
LOWER
CALIFORNIA
SCALE IN MILES
INSET MAP

SAN DIEGO BASIN
SEWERED AND FRINGE AREAS
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 4

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